

# NASA Technical Memorandum 58244

## Full-Scale Flammability Test Data for Validation of Aircraft Fire Mathematical Models

FOR REFERENCE

Jerome F. Kuminecz and Richard W. Bricker  
*Lyndon B. Johnson Space Center  
Houston, Texas*

NOT TO BE TAKEN FROM THIS ROOM

LIBRARY COPY

APR 27 1982

LANGLEY RESEARCH CENTER  
LIBRARY, NASA  
HAMPTON, VIRGINIA

**NASA**  
National Aeronautics and  
Space Administration

Scientific and Technical  
Information Office  
1982





NASA Technical Memorandum 58244

# Full-Scale Flammability Test Data for Validation of Aircraft Fire Mathematical Models

Jerome F. Kuminecz and Richard W. Bricker

February 1982



National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
Houston, Texas

*N82-21166 #*



## CONTENTS

Section	Page
SUMMARY . . . . .	1
INTRODUCTION . . . . .	1
TEST FACILITY . . . . .	2
TEST CONDITIONS . . . . .	2
Cabin Size . . . . .	2
Fire Location . . . . .	2
Size of Ignition Source . . . . .	2
Ventilation . . . . .	3
Cabin Materials . . . . .	3
INSTRUMENTATION . . . . .	3
Temperature . . . . .	3
Visibility . . . . .	4
Heat Flux . . . . .	4
Air Velocity . . . . .	4
Fuel Weight . . . . .	4
Seat Weight . . . . .	4
Gas Collection and Analysis . . . . .	4
Visual Documentation . . . . .	5
RESULTS . . . . .	5
Photographs . . . . .	5
Graphs . . . . .	5
Visibility and Heat Flux . . . . .	6
Temperatures . . . . .	6
Ventilation . . . . .	6
Fuel Weight Loss . . . . .	7
Cabin Materials Weight Loss . . . . .	7
Gas Collection and Analysis . . . . .	7
Hydrolyzable gases . . . . .	8
Nonhydrolyzable gases . . . . .	8
DISCUSSION . . . . .	8
Fuel-Only Tests . . . . .	8
Four and 1/2-liter and 2-1/2-liter fuel tests . . . . .	8
One-liter fuel tests . . . . .	9
Small cabin fuel tests . . . . .	9
Cabin Materials Tests . . . . .	9
Full-up materials configuration . . . . .	9
Individual components . . . . .	10
Polyimide vs. urethane foam . . . . .	10
Distribution of Peak Gas Concentrations . . . . .	11
CONCLUDING REMARKS . . . . .	11
REFERENCES . . . . .	13

TABLES

Table		Page
I	TEST CONDITIONS . . . . .	14
II	CABIN PANEL MATERIALS . . . . .	15
III	ORDER OF GRAPHS PRESENTED FOR EACH TEST (PLUS INSTRUMENTATION DESIGNATIONS) . . . . .	16
IV	TEST GRAPHS PROVIDED . . . . .	18
V	OUTSIDE AIR PRESSURE, TEMPERATURE, AND HUMIDITY . . . . .	19
VI	PRE-TEST AIR VELOCITY MEASUREMENTS . . . . .	20
VII	MAXIMUM GAS CONCENTRATIONS DETECTED . . . . .	21
VIII	SEAT AND WALL PANEL WEIGHT LOSS . . . . .	22
IX	OVERHEAD PANEL WEIGHT LOSS . . . . .	23

## FIGURES

Figure

Page

### CONFIGURATION OF TEST INSTRUMENTATION

#### PART A - OVERALL CONFIGURATION AND IDENTIFICATION OF INSTRUMENTATION

1	Boeing 737 Fuselage Test Section . . . . .	26
2	Overall Configuration of Tree T/Cs, Calorimeters, Smoke Meters, Fuel Pans, and Cameras . . . . .	27
3	Air Velocity Probes . . . . .	28
4	Gas Collection Ports . . . . .	29
5	Fuselage Instrumentation (View Facing Aft) . . . . .	30
6	Fuselage Instrumentation (View Facing Forward) . . . . .	31
7	Overhead and Wall Panel T/C's . . . . .	32
8	Seat Cushion T/C's . . . . .	33
9	Seat Back T/C's . . . . .	34
10	Full-up Cabin Materials Configuration (Seats, and Wall, PSU, Bin, and Ceiling Panels) . . . . .	35
11	Fuel Pan T/C's . . . . .	36
12	Other T/C's . . . . .	37

#### PART B - GAS COLLECTION AND ANALYSIS SYSTEMS

13	Overall Configuration of Gas Collection Systems . . . . .	39
14	Components of Wet Gas Collection System . . . . .	40
15	Wet Gas Collection System (Plus Early Dry Gas Collection System) . . . . .	41
16	Dry Gas Collection and Analysis System Console . . . . .	42

#### PART C - ADDITIONAL THERMOCOUPLE DETAILS

17	Thermocouple Tree T/C Locations (and Overhead Panel Heights) . . . . .	44
18	Thermocouple Tree Locations . . . . .	45
19	Overhead Panel T/C Locations . . . . .	46

Figure	Page
20 Wall Panel T/C Locations . . . . .	47
21 Seat Cushion and Back T/C Locations . . . . .	48
PART D - ADDITIONAL DETAILS - OTHER INSTRUMENTATION	
22 Calorimeter Locations . . . . .	50
23 Smoke Meter Locations . . . . .	51
24 Air Inlet Diffuser . . . . .	52
25 Aft Air Velocity Probes . . . . .	53
26 Components of Fuel Ignition and Fuel Weighing Systems . . .	54
27 View of Fuel Ignition and Fuel Weighing Systems . . . . .	55
28 Dimensions of Seat Assembly Weighing System . . . . .	56
29 View of Seat Assembly Weighing System . . . . .	57

Figure		Page
	<u>TEST PHOTOGRAPHS AND GRAPHS</u>	
30-45	Test 1 - Fuel Only . . . . .	59-79
46-61	Test 2 - Fuel Only . . . . .	80-100
62-77	Test 3 - Fuel Only . . . . .	101-122
78-94	Test 4 - Fuel Only . . . . .	123-145
95-111	Test 5 - Fuel Only . . . . .	146-167
112-128	Test 6 - Fuel Only . . . . .	168-188
129-139	Test 10 - Fuel Only . . . . .	190-203
140-156	Test 11 - Fuel Only . . . . .	204-228
157-188	Test 12 - Bare Urethane Foam Seats (Cushions Only) . . .	229-264
189-221	Test 13 - Bare Urethane Foam Seats (Backs Only) . . . . .	265-306
222-253	Test 14 - Bare Urethane Foam Seats (Cushions Only) . . .	307-340
254-286	Test 15 - Bare Urethane Foam Seats . . . . .	341-382
287-317	Test 16 - Bare Upjohn 9700 WFR Foam Seats . . . . .	383-420
318-352	Test 17 - Covered Urethane Foam Seats . . . . .	421-460
353-385	Test 18 - Bare IH-1720 Polyimide Foam Seats . . . . .	461-500
386-418	Test 19 - Wall Panel . . . . .	501-536
419-450	Test 20 - PSU, Bin, and Ceiling Panels . . . . .	537-570
451-483	Test 21 - PSU, Bin, and Ceiling Panels . . . . .	571-608
484-503	Test 22 - Fuel Only . . . . .	609-634
504-541	Test 23 - Wall, PSU, Bin, and Ceiling Panels . . . . .	635-674
542-586	Test 24 - Covered Urethane Foam Seats, and Wall, PSU, Bin, and Ceiling Panels . . . . .	675-724
587-621	Test 25 - Covered Urethane Foam Seats . . . . .	725-764
622-646	Test 26 - Fuel Only . . . . .	765-792
647-669	Test 27 - Fuel Only . . . . .	793-818
670-710	Test 28 - Covered Urethane Foam Seats, and Wall, PSU, Bin, and Ceiling Panels . . . . .	819-865

# MATRIX OF GRAPH FIGURE NUMBERS

← Temperature Graphs | Other Graphs →

Test No.	Cabin Materials	T/C Tree	Head Panel	Wall Panel	Seat Cushion	Seat Back	Fuel Pan	Inlet + Exit	Ceiling + Floor	Shielded	Light Trans-mission	Heat Flux	Air Velocity	Fuel Wt Loss	Seat Wt Loss	Wet Gas	Dry Gas
1	None - fuel only	30					37	38			39	40					43
2	None - fuel only	46					53	54			55	56					59
3	None - fuel only	62					69	70			71	72					75
4	None - fuel only	78					85	86			87	88		90			92
5	None - fuel only	95					102	103			104	105		107			109
6	None - fuel only	112					119	120			121	122		124			126
10	None - fuel only																132
11	None - fuel only	140					147	148	149		150	151	153	154			
12	Seats (cushions)	160			167		169	170	171		172	173	175	176	177	178	181
13	Seats (backs)	192				199	202	203	204		205	206	208	209	210	211	214
14	Seats (cushions)	225			232		234	235	236		237	238	240	241	242	243	246
15	Seats	257			262	264	267	268	269		270	271	273	274	275	276	279
16	Seats (Upjohn)	290			295	297	300	301	302		303	304	306	307		308	310
17	Seats	323			328	330	333	334	335		336	337	339	340	341	342	345
18	Seats (polyimide)	356			363	365	368	369	370		371	372	374	375		376	378
19	Wall panel	389		396			400	401	402		403	404	406	407		408	411
20	Overhead panels	422	429				434	435	436		437	438	440	441			443
21	Overhead panels	453	460				465	466	467		468	469	471	472		473	476
22	None - fuel only	484					491	492	493		494	495	497	498			500
23	All panels	507	514	519			523	524	525		526	527	529	530		531	534
24	Seats & all panels	547	554	559	563	565	568	569	570		571	572	574	575		576	579
25	Seats	590			597	599	602	603	604		605	606	608	609	610	611	614
26	None - fuel only	625					630	631	632	633	634	635		637			639
27	None - fuel only	650					655	656	657	658	659	660		662			664
28	Seats & all panels	671	678	683	687	689	692	693	694	695	696	697	699			700	703



## SUMMARY

Twenty-five large-scale aircraft flammability tests were conducted in a Boeing 737 fuselage at the NASA Johnson Space Center (JSC). The objective of this test program was to provide a data base on the propagation of large-scale aircraft fires to support the validation of aircraft fire mathematical models. Variables in the test program included cabin volume, amount of fuel, fuel pan area, fire location, airflow rate, and cabin materials. A number of tests were conducted with Jet A-1 fuel only, while others were conducted with various Boeing 747-type cabin materials. These included urethane foam seats, passenger service units, stowage bins, and wall and ceiling panels. Two tests were also included using special urethane foam and polyimide foam seats. Tests were conducted with each cabin material individually, with various combinations of these materials, and finally, with all materials in the cabin. The data include information obtained from approximately 160 locations inside the fuselage. Measurements include temperature, visibility, heat flux, air velocity, rate of fuel and seat weight loss, and concentration of various gases. The data provided by this report include nearly 3000 curves (shown on 600 graphs). A matrix is included to quickly locate any particular graph. Approximately 50 before, during, and after test photographs are also included.

## INTRODUCTION

Primary emphasis in aircraft fire safety activities over the last few years has been on materials development and flammability testing. Recently, aircraft fire modeling activities have generated models which address the full-scale aircraft fire, including propagation through the fuselage. One such model has been developed at the University of Dayton Research Institute (UDRI) for the Federal Aviation Administration (ref. 1). It consists of a simulation of a fire propagating through a wide-body aircraft fuselage from an ignition source. The model was developed to predict the temperatures, heat flux, smoke, and gas combustion products from burning interior materials in a full-scale aircraft cabin fire, using laboratory test data of the same materials. Validation of this type of model requires detailed fire data from full-scale tests. Previous full-scale tests in the industry were not sufficiently instrumented to provide the extensive data necessary.

A specific test program was developed by JSC in coordination with UDRI to provide the fire data necessary for validation of the UDRI model. The program obtained data on each element of the fire propagation path, including the ignition source and the fire buildup data for each major element of the aircraft interior materials. The locations and types of necessary instrumentation were determined through coordination with UDRI math modeling personnel. A total of 25 tests were included in the program. Detailed data from the fires produced in these tests form the basis of this report, which is primarily a data report, with limited data interpretation. Correlation with the UDRI model is not included. Although

these tests were originally conducted to support the UDRI model, this report was written with general applicability in mind.

## TEST FACILITY

The test facility is a Boeing 737 aircraft fuselage (fig. 1). The fuselage has movable bulkheads which can provide a test compartment as short as 3 meters (10 feet), or as long as 17.1 meters (56 feet). The center section of the fuselage (6.1 meters (20 feet) long) as well as the aft bulkhead area, have been lined with a high-temperature insulation (Fiberfrax), and covered with a stainless steel skin to protect the aluminum structure and the external skin from damage. The remainder of the fuselage is fitted with bagged aircraft Fiberglas insulation and covered with aluminum skin. The fuselage interior is protected with a fire extinguishing system for terminating tests exceeding acceptable limits. A ventilation system and a computerized control and data acquisition system support the test facility.

## TEST CONDITIONS

The primary test conditions under which these tests were conducted are shown in table I, and are described below. Twenty-five tests were conducted. Tests were numbered 1 through 28, with test numbers 7 through 9 omitted.

### Cabin Size

Two different cabin lengths, 17.1 meters and 6.1 meters, were used. The cabin volume was 104 cubic meters (3700 cubic feet) in the large section, and 37 cubic meters (1320 cubic feet) in the small section. All but two of the tests were conducted in the large section.

### Fire Location

As shown in figure 2, the fuel pan was located in one of three positions. Position A, the midline outboard wall position (beneath the center of the outboard seat), was used in most of the tests, including all the cabin materials tests.

### Size of Ignition Source

In a previous test program conducted by JSC with the Boeing Commercial Aircraft Company (ref. 3), various sizes of fuel fires were evaluated to determine an optimum ignition source. The optimum test ignition source was defined to be that source which produces a free air temperature of 478 K (400° F), at 1.5 meters (5 feet) above the floor, at a distance of 2.4 meters (8 feet) from the center of the fire, in approximately 4 minutes

after ignition. This temperature is considered the maximum human tolerance for short exposure times. The results of the test program with Boeing indicated that a 61-centimeter (2-foot) square fuel pan with 4.5 liters of Jet A-1 fuel would produce the desired temperature.

Three ignition sources were used in the current test program. Four and 1/2 liters of Jet A-1 fuel, in a 61-centimeter (2-foot) square fuel pan, were used in most of the fuel-only tests, and where wall and/or overhead panels were tested without seats. Two and 1/2 liters of Jet A-1 fuel were also used, but only in the first two tests. One liter of Jet A-1 fuel, in a 31-centimeter (1-foot) square fuel pan, was primarily used during tests with seats to limit the size of the fire produced.

### Ventilation

Test air ventilation rates ranged from 14.2 to 65 m<sup>3</sup>/min (500 to 2300 ft<sup>3</sup>/min). The direction of airflow was from a diffuser in the forward bulkhead door (fig. 24) toward the open aft bulkhead door (fig. 25). The outside air pressure, temperature, and humidity conditions which existed for each test are shown in table V. Pre-test air velocity measurements, including outside wind velocity and direction, and natural and forced ventilation velocities, are shown in table VI.

### Cabin Materials

Most of the materials used were Boeing 747-type aircraft cabin furnishings cut to size to fit inside the JSC Boeing 737 test section. Included were urethane foam seat assemblies and wall panels, as well as an assembly of nine overhead panels, which included two passenger service unit (PSU) panels, two stowage bin panels, and five ceiling panels. In addition, there were two tests using special urethane and polyimide foam seats. Tests generally progressed from those with no materials (Jet A-1 fuel only), to single cabin components, to component combinations, and finally with all cabin materials installed (fig. 10).

### INSTRUMENTATION

The instrumentation used in this test program is shown in figures 1 through 29. Identification numbers for the instrumentation are shown in table III, and figures 2 through 12. A brief description of the instrumentation is also given below.

### Temperature

Chromel-alumel thermocouples were used to measure free-air and material temperatures. They were installed at over 130 locations (figs. 2, 7 to 9, 11, 12, and 17 to 21). Thermocouples which were installed on cabin materials were referred to by the designation "T/M".

## Visibility

Six National Bureau of Standards (NBS) photometric smoke measurement systems (ref. 2) were installed to determine the loss of visibility resulting from the smoke generated by the fuel and the burning materials. Their locations are shown in figures 2 and 23. Scales for monitoring smoke stratification, and lamps for illuminating the scales, were also installed (fig. 17).

## Heat Flux

Six water-cooled calorimeters were installed, as shown in figures 2 and 22, to determine the heat flux generated by the fire. Three were located on the midline of the fuselage, around the fire, while the remaining three were located near the aft end of the fuselage.

## Air Velocity

To determine airflow velocity through the fuselage, three bidirectional gas velocity probes were installed, as shown in figures 3 and 25. Two were installed in the aft fuselage doorway, and one near the ceiling at thermocouple tree 5, just forward of the midsection of the fuselage. The probes used were similar to the one described in reference 4.

## Fuel Weight

Fuel pan weight measurements were made continuously during the test to give an indication of the rate of fuel consumption. Fuel pan weight change was obtained through the use of a lever suspension system. The pan was mounted on the end of a balance arm, opposite a load cell, as shown in figures 26 and 27.

## Seat Weight

To measure seat weight changes with time, a load cell was suspended from a bracket external to the fuselage directly over the seat position, as shown in figures 28 and 29. A steel cable connected to the load cell was passed through an opening in the fuselage to a bridle system, which held the seat assembly.

## Gas Collection and Analysis

Two different systems were used to collect and analyze the products of combustion. The overall configuration of both systems is shown in figure 13. The dry gas system (console shown in figure 16) collected and analyzed gas samples from six sample port locations, shown in figure 4. The system included real-time gas analyzers, one for each of four non-hydrolyzable gases: carbon monoxide, carbon dioxide, oxygen, and light

hydrocarbons (up to six carbon atoms). Prior to installation of this system (for the first six tests only), 32-liter stainless steel vessels were used to collect gas samples, which were later analyzed. The wet gas system, shown in figures 14 and 15, used glass bubblers filled with sodium hydroxide solution to collect three types of hydrolyzable gas ions (cyanides, fluorides, and chlorides) from four sample port locations. The collection lines were heated to 66° C (150° F) to avoid condensation losses, and the test solutions collected were analyzed using solid-state specific ion electrodes.

### Visual Documentation

Visual documentation of the ignition and flame propagation in the cabin was obtained using up to three motion picture cameras at different angles. Still photography documented before, during, and after conditions of the test specimens. Closed-circuit television was used for real-time viewing. The relative locations of the cameras are shown in figure 2.

## RESULTS

The results of this test program are presented in tables, photographs, and graphs. A dash (-) symbol indicates which data in the tables were applicable for a particular test, but were deleted because of equipment malfunction, or were otherwise not available for inclusion in this report. The test photographs and graphs of the data are grouped numerically, from test 1 through 28, in separate sections at the end of this report.

### Photographs

Photographs are included before the graphs for each test, except for the first six fuel-only tests, which were not photographed. Three photographs are usually included for each test. The first photograph is the pre-test configuration of the cabin materials. The second photograph is usually the same view taken after the test to document the extent of fire damage. The third photograph is one selected from photographs taken by a camera inside the fuselage test section during the fire itself. An attempt was made to select a photograph for each test which showed the fire when the flame area was at or near its maximum visible size.

Labels were used to identify instrumentation on selected test photographs. Although the majority of the pre-test photos have some labels, most of the instrumentation seen in the photos have been identified on three photos in particular. These are figures 189, 419, and 542, for tests 13, 20, and 24, respectively.

## Graphs

The order in which the graphs are presented for each test in this report is listed in table III, which also includes instrument identification numbers. Applicable instrument numbers are listed in the legend on each graph. The types of graphs provided for each particular test are shown in table IV. To locate any graph quickly, refer to the matrix of graph figure numbers at the end of the Table of Contents.

To minimize the size of this report, up to six curves were plotted on each graph. Wherever a curve on a graph indicated that an instrument was malfunctioning from the beginning of a test, the letters "N.A." were inserted in the legend of the graph to indicate which curve was deleted. Whenever a malfunction occurred sometime after the start of a test, only that portion of the curve was deleted which was obviously in error.

## Visibility and Heat Flux

The visibility and heat flux data are shown in the graphs. There were no basic changes in the configuration of these instruments during the test program.

## Temperature

All the temperature data (except for the ambient outside air temperatures given in table V) are included in the graphs. The thermocouple tree and cabin materials' thermocouple positions were not basically changed during the test program. However, changes and/or additions of other thermocouples were made. There was only one thermocouple above the fuel pan for the first six tests, after which three thermocouples were used (fig. 11). These thermocouples were usually located above the center of the fuel pan except when seats were tested, when they were located as close to the fuel pan as permitted by the seat assembly. The four ceiling and floor thermocouples were not added until after test 6. They were installed near the ceiling and the floor, at trees 1 and 4, to provide additional air temperature readings near cabin surfaces. In addition, two thermocouples shielded from direct radiation were installed next to two unshielded thermocouples to determine the effects of flame radiation on thermocouple readings; however, this was done only in the last three tests.

## Ventilation

The outside air pressure, temperature, and humidity measurements taken just before each test run are shown in table V. Beginning with test 14, pre-test air velocity measurements were also made of outside wind velocity and direction, as well as natural and forced ventilation velocities, which are shown in table VI. The airflow rates which were used during each test are listed in table I.

The air velocity measurements taken during the tests at the three velocity probe positions (V1 and V2 in the aft bulkhead doorway, and V3

forward of the fuselage midline) are shown in the graphs beginning after test 6, when the two aft velocity probes were installed. The probes used are bidirectional and are relatively insensitive to the angle of direction of airflow up to  $\pm 50$  degrees. They are considered accurate to  $\pm 10$  percent for air velocities above  $\pm 0.3$  m/sec (0.9 ft/sec). Below this, their accuracy decreases significantly. The direction of airflow at V1 and V2 was almost always aft, which was designated as the positive (+) direction on the graphs. Airflow at V3 was usually negative, indicating forward flow.

The air inlet into the fuselage test section was a 20-centimeter (8-inch) diameter port to the right of the forward fuselage door for only the first six tests, after which a diffuser type of inlet port was installed in the center of the fuselage door. The exit port was always the open aft fuselage doorway. Tests 3 and 6 were natural ventilation tests with the blower off and both forward and aft doors open. Test 10 (at fuel pan location "C", next to the aft bulkhead) was the only test conducted with the aft vent door closed, with air vented out through the Boeing 737's floor vents, which were normally taped over.

#### Fuel Weight Loss

The fuel weight loss with time is shown in the graphs. When it was obvious that a piece of material fell into the fuel pan, this was noted on the graph. The earliest time for fuel depletion was 11 minutes in test 16. However, in most tests, when the test graphs were terminated after 14 minutes, there was usually still a small amount of burning fuel left. There exist no fuel weight loss data for the first three tests. Water was used in the fuel pan in these tests to help provide a constant burning area, with the fuel floating on it. However, when the water boiled, it also threw out some fuel, which affected the weight loss measurements. The water was deleted after the first three tests.

#### Cabin Materials Weight Loss

The total weight loss of the cabin materials used (seats, wall, and overhead panels) is shown in tables VIII and IX. Graphs of seat weight loss with time are also provided. Since the seats in tests 12 to 16 and test 18 did not include any significant weight of flammable material other than the foam seats themselves, the seat weight loss graphs for these six seat tests would tend to indicate the rate of consumption of just the foam itself with time. The other four tests with seats (tests 17, 24, 25, and 28) included a number of flammable materials in the seat assembly in addition to the foam seats. Therefore, the total weight loss of the entire seat assembly (test fixtures, foam armrests, plastic tray and back supports, instrumentation, and foam seats) was plotted in these four tests. In some tests, a large piece of burning material would fall off the seat assembly. The weight loss curve was usually deleted after this point.

## Gas Collection and Analysis

Graphs of concentrations of products of combustion are provided. The maximum concentrations which were detected of each gas, as well as the minimum level of oxygen, are presented in table VII.

Hydrolyzable gases.- Hydrolyzable gases were collected by the wet gas collection system in glass bubblers filled with sodium hydroxide solutions, and were analyzed for cyanide, fluoride, and chloride ions. The usual sampling interval for each bubbler was 2 minutes, and six bubblers for each port provided for a total sample time of 12 minutes. The ports most often used were three aft ports (A8, A16, and A8L) and one forward port (F16). The numbers 8 and 16 indicate port distance in feet from the fuselage midline. Test 13 was the first test in which the wet gas collection was upgraded to cover four ports. Previous tests were limited to only two wet gas ports. Past experience has indicated that free cyanide, fluoride, and chloride ions collected in aircraft fires were primarily provided by the hydrolyzable gases, hydrogen cyanide, hydrogen fluoride, and hydrogen chloride. Therefore, the graphs (and table VII) indicate concentrations in these three gases.

Nonhydrolyzable gases.- Four nonhydrolyzable gases (carbon monoxide, carbon dioxide, oxygen, and light hydrocarbons) were collected and analyzed in real time by the dry gas collection system. Gas samples were collected and analyzed at each port every 60 seconds. Six dry gas collection ports were usually used, including three aft ports (A8, A16, and A8L) and three forward ports (F8, F16, and F8L). The real-time gas collection and analyzer system was not operational to provide coverage for six ports until after test 6. The first six tests were limited to only two dry gas ports, when samples were collected in 32-liter stainless steel vessels, which limited the total sampling time to only the first 5 minutes after ignition. In the two tests conducted in the 6.1-meter section, ports A4 and F4 were used instead of ports A16 and F16. The graphs of hydrocarbon concentrations were plotted in methane ( $\text{CH}_4$ ) equivalent concentrations.

## DISCUSSION

### Fuel-Only Tests

As shown in table I, the fuel-only tests, with no cabin materials present, included nine tests (tests 1 to 6, 10, 11, and 22) in the 17.1-meter test section. There were also two fuel-only tests conducted in the 6.1-meter section (tests 26 and 27).

Four and 1/2-liter and 2-1/2-liter fuel tests.- The data indicate that most of the results from tests 1 to 6 and 10 were very consistent and repeatable. The peak gas concentrations for these seven fuel-only tests were particularly consistent. The maximum carbon monoxide ( $\text{CO}$ ) concentrations varied only from 401 to 517 ppm, the maximum carbon dioxide ( $\text{CO}_2$ ) concentrations from 1.43 to 2.09 percent, and the minimum oxygen ( $\text{O}_2$ ) concentrations from 17.8 to 18.9 percent. Hydrocarbon concentrations were



not determined for the first six tests. As would be expected, no cyanides, fluorides, or chlorides were found in the fuel-only tests. The fact that similar gas concentrations and other results were also produced by the two 2-1/2-liter fuel tests (tests 1 and 2) was probably due to the first two tests having a much lower ventilation rate, as shown in table I, which would increase the buildup of heat and combustion products.

The peak temperature on thermocouple tree 4 at the fuselage midline is usually the highest measured air temperature in the fuselage, except for directly over the fuel pan itself. This peak temperature was similar in four of six fuel tests. (No additional data on the seventh test in the series (test 10) are available, and it will not be discussed further.) Tests 1 to 3 and test 5 had maximum thermocouple tree temperatures between 510° and 565° C (950° and 1050° F), while tests 4 and 6 had maximum temperatures of approximately 288° C (550° F). While this difference is large, it should be noted that these are peak temperatures at thermocouple tree 4, which is nearest the fire, and as such are subject to much greater variation than at other thermocouple trees. In fact, the maximum temperatures at the other tree locations were consistent in all six tests, with most maximum temperatures between 204° and 260° C (400° and 500° F). All six tests had peak heat fluxes (except for a single brief higher spike) between  $1.2$  to  $2.7 \times 10^4$  W/m<sup>2</sup>. All six tests resulted in approximately 90 percent loss of visibility due to smoke about 1 minute after ignition, with 98 to 100 percent loss by 2 minutes. (The 1-liter fuel tests also generated much smoke from the Jet A-1 fuel used, which was expected because of the nature of the fuel. However, 1 liter alone did not cause more than 80 percent visibility loss at any time, and much less most of the time.)

One-liter fuel tests.— Data from both 1-liter tests in the 17.1-meter section (tests 11 and 22) were generally consistent. As would be expected, much lower levels in all test parameters were produced compared to the 2-1/2-liter and 4-1/2-liter fuel-only tests.

Small cabin fuel tests.— Two tests (tests 26 and 27) were conducted in the 6.1-meter test section. The only difference between these tests was that test 26 was conducted with 4.5 liters of fuel in the large fuel pan, and test 27 with 1 liter in the small pan. As expected, the effects of this large difference in amount of fuel and pan size was substantial, and is clearly indicated by the differences in peak values. The maximum gas concentrations produced in tests 26 and 27 were 3.53 and 0.92 percent CO<sub>2</sub>, and 304 and 89 ppm light hydrocarbons; and the minimum oxygen levels were 15.4 to 19.6 percent, respectively. The maximum CO level in test 26 was 604 ppm. CO data for test 27 were not available. The temperatures and heat flux also varied similarly. The maximum thermocouple tree air temperature was 592° C (1100° F) in test 26, and 193° C (380° F) in test 27. The maximum heat flux was  $5.5 \times 10^4$  W/m<sup>2</sup> in test 26, and  $0.9 \times 10^4$  W/m<sup>2</sup> in test 27.

#### Cabin Materials Tests

Full-up materials configuration.— Tests 24 and 28 were the only two tests conducted in the full-up materials configuration, in which all cabin

material components were installed (seats, wall panel, and overhead panels). As expected, these tests usually produced the highest gas concentrations, temperatures, heat flux, damage, and other parameter levels of any of the tests conducted in this test program, with test 28 generally producing the much higher of the two. The highest peak levels were produced in test 28 because 4.5 liters of fuel were used in this test, while test 24 was conducted with only 1 liter of fuel. The maximum gas concentrations in test 28 were extremely high. Since gas concentrations were usually collected in 1- or 2-minute intervals, actual maximum concentrations were probably greater than shown. The maximum concentrations determined in test 28 were: 1230 ppm hydrogen cyanide (HCN), 780 ppm hydrogen fluoride (HF), 2040 ppm hydrogen chloride (HCl), 11 500 ppm CO, 9.69 percent CO<sub>2</sub>, and 7339 ppm light hydrocarbons. The minimum oxygen level was 9.6 percent. The maximum thermocouple tree air temperature in test 28 was approximately 1038° C (1900° F). The maximum seat temperature was approximately 982° C (1800° F), the peak wall panel temperature was approximately 815° C (1500° F), and the peak overhead panel temperature was approximately 982° C. The maximum heat flux recorded in test 28 was approximately  $13 \times 10^4$  W/m<sup>2</sup> before all 6 calorimeters became inoperable.

Individual components.- As expected, the tests conducted on individual cabin components (seats, wall panel, or overhead panels) produced much lower values than in the full-up tests in nearly all test parameters. The seats usually had a greater effect on conditions than the panels because of their greater volume of material in close proximity to the flames, enabling continuous direct flame impingement throughout most of the test.

Polyimide vs. urethane foam.- Differences between the polyimide and urethane foams tested were large, as indicated in the results of tests 18 and 15. Test 18 was a seats-only test with bare IH-1720 polyimide foam provided by International Harvester Corporation. Test 15 was a bare seats-only test conducted with the standard fire-retardant urethane foam used throughout this test program. It is typical of the urethane foam in use in many commercial wide-body aircraft. The amount of fuel, pan size and location, airflow rate, and most other test conditions were similar in both tests. The maximum gas concentrations for the polyimide foam were extremely low, both when compared to the urethane foam, and in absolute terms. In fact, they were just above the levels produced by 1 liter of Jet A-1 fuel itself. The peak hydrogen cyanide concentrations were 165 ppm for the urethane seats, compared to 6 ppm for the polyimide seats. The peak hydrogen chloride concentrations were 570 ppm for urethane, and were not detected (<6 ppm) for polyimide. Maximum carbon monoxide concentrations were 3209 and 294 ppm, carbon dioxide levels were 2.33 and 0.46 percent, light hydrocarbon levels were 1200 and 189 ppm, and minimum oxygen levels were 18.5 and 20.2 percent, respectively.

The maximum thermocouple tree air temperature was 732° C (1350° F) for the urethane foam, compared to 121° C (250° F) for the polyimide foam. The maximum temperatures reached by most of the thermocouples on the urethane foam were approximately 870° C (1600° F), but below 204° C (400° F) in most areas of the polyimide foam. The maximum heat flux produced by the polyimide foam was  $0.7 \times 10^4$  W/m<sup>2</sup>. Maximum heat flux data for the urethane foam were not available. The loss in visibility was total with the urethane foam seats, but only a maximum of 80 percent with the poly-

imide foam. This is about the same loss in visibility that 1 liter of Jet A-1 fuel would produce by itself. The weight loss of the urethane foam seats was 83 percent. While the exact weight loss figures for the polyimide foam were not available, the post-test photograph (fig. 354) indicates that only about 10 to 15 percent of the total weight of the three seats was consumed. A post-test photograph of the urethane foam seats is shown in figure 255.

#### Distribution of Peak Gas Concentrations

The distribution of the peak concentrations of each of the seven gases analyzed (HCN, HF, HCl, CO, CO<sub>2</sub>, O<sub>2</sub>, and light hydrocarbons) at each of the six primary gas collection port locations (A8, A16, A8L, F8, F16, and F8L) was checked after most of the tests. As expected, certain ports usually collected higher concentrations of most of the gases than other ports. About 80 percent of the time, aft port A16 collected the highest concentrations of gases. When not the highest concentration port, it was rarely below second highest. The aft ports would be expected to receive the highest gas concentrations due to the direction of forced air ventilation from forward to aft. The A16 port would usually have higher gas concentrations than either of the other two aft ports (A8 and A8L) because the updraft and turbulence of air near the fire would tend to reduce the amount of gas products which would reach these two ports near the fire. The further away from the fire, and also the nearer the bulkheads were, the lower one would expect layers of hot gases to settle. The second highest port was usually A8, and the third and fourth highest ports were usually F16 and F8. The two ports which usually had the lowest gas concentrations were A8L and F8L. This was expected, since these two ports were at a height of only 0.8 meters (2.5 feet), compared to a height of 1.5 meters (5 feet) for the other four ports. Lesser amounts of combustion products would tend to reach this lower height, especially so close to the updraft of the fire.

#### CONCLUDING REMARKS

The results indicate that the objectives of this test program have been accomplished. The data contained in this report are considered to be at a level of detail and consistency to provide a significant data base for supporting the validation of aircraft fire mathematical models.

Some general observations are included below. Although these results were expected, they tend to indicate some of the overall consistency of the great majority of data provided by this test program.

1. Peak values of all test parameters were much greater in the 4-1/2-liter fuel tests in the large fuel pan, compared to the 1-liter fuel tests in the small fuel pan. It was expected that the amount and the area of the liquid fuel available to a fire would have a major effect.

2. Peak values in tests with all materials present were much greater than where only one material component was used, as expected.

3. Lower air ventilation rates provided higher peak values in most parameters than higher ventilation rates, because of the slower venting of hot and toxic gases.

4. The standard aircraft urethane foam seats tested provided much higher peak values in all test parameters than did polyimide foam seats.

Users of this report can contact Mr. Jerome Kuminecz of the Materials Technology Branch, NASA Lyndon B. Johnson Space Center, Houston, Texas, 77058, if any additional information is desired on this test program.

Lyndon B. Johnson Space Center  
National Aeronautics and Space Administration  
Houston, Texas, February 9, 1982  
534-05-00-61-72

## REFERENCES

1. Reeves, J. B.; and MacArthur, C. D.: Dayton Aircraft Cabin Fire Model. Report No. FAA-RD-76-120, University of Dayton Research Institute, 1976.
2. Bukowski, Richard W.: Instruction Manual for NBS Photometric Smoke Measurement System. NBSIR-77, National Bureau of Standards, 1977.
3. Tustin, E. A.: Development of Fire Test Methods for Airplane Interior Materials. NASA CR-160119, 1978.
4. McCaffrey, B. J.; and Heskestad, G.: A Robust Bidirectional Low-Velocity Probe for Flame and Fire Application, pp. 125-127, Combustion and Flame 26, 1976.

TABLE I.- TEST CONDITIONS

Test No.	Pan size <sup>a</sup>	Pan location <sup>b</sup>	Airflow rate, m <sup>3</sup> /min (ft <sup>3</sup> /min)	Cabin materials
1	2 <sup>c</sup>	A	14.7 (520)	None - fuel only
2	2 <sup>c</sup>	B	14.7 (520)	None - fuel only
3	2	B	<sup>d</sup>	None - fuel only
4 <sup>e</sup>	2	A	43.9 (1550)	None - fuel only
5	2	A	43.9 (1550)	None - fuel only
6	2	B	<sup>d</sup>	None - fuel only
10 <sup>f</sup> /g	2	C	43.9 (1550)	None - fuel only
11	1	A	43.9 (1550)	None - fuel only
12	1	A <sup>h</sup>	43.9 (1550)	Bare urethane foam seats (cushions only) <sup>i</sup>
13	1	A	62.2 (2200)	Bare urethane foam seats (backs only)
14	1	A	62.2 (2200)	Bare urethane foam seats (cushions only)
15	1	A	65.0 (2300)	Bare urethane foam seats
16	1	A	62.2 (2200)	Bare Upjohn 9700 WFR foam seats
17	1	A	62.2 (2200)	Covered urethane foam seats <sup>j</sup>
18	1	A	62.2 (2200)	Bare IH-1720 polyimide foam seats
19	2	A	62.2 (2200)	Wall panel
20	2	A	62.2 (2200)	PSU, bin, and ceiling panels
21	2	A	18.4 (650)	PSU, bin, and ceiling panels
22	1	A	56.6 (2000)	None - fuel only
23	2	A	14.2 (500)	Wall, PSU, bin, and ceiling panels
24	1	A	14.2 (500)	Covered urethane foam seats and wall, PSU, bin, and ceiling panels
25	1	A	14.2 (500)	Covered urethane foam seats
26 <sup>k</sup> /l	2	A	14.2 (500)	None - fuel only
27 <sup>k</sup>	1	A	14.2 (500)	None - fuel only
28	2	A	14.2 (500)	Covered urethane foam seats and wall, PSU, bin, and ceiling panels

<sup>a</sup>The number 2 indicates the 61- by 61-centimeter (2- by 2-foot) fuel pan size, which contained 4.5 liters of fuel. The number 1 indicates the 31- by 31-centimeter (1- by 1-foot) pan size, which contained 1.0 liters of fuel.

<sup>b</sup>Refer to test configuration schematic for locations of fuel pan (fig. 2).

<sup>c</sup>Only 2.5 liters of fuel were used in tests 1 and 2.

<sup>d</sup>Natural ventilation was used for tests 3 and 6.

<sup>e</sup>Began fuel weight loss with time measurements in test 4 (to 28).

<sup>f</sup>Tests 7 to 9 were not part of this test program.

<sup>g</sup>The following additions were made which apply to test 10 (to 28): increased number of thermocouples above fuel pan from 1 to 3; provided ceiling and floor thermocouples at trees 1 and 4; and installed two flow meters in aft doorway.

<sup>h</sup>The fuel pan was under the center seat in test 12.

<sup>i</sup>Except for tests 16 and 18, seats used were fire-retardant urethane foam aircraft seats of the type used in many wide-body aircraft (manufactured by Hartman Co.).

<sup>j</sup>The seat covers used in all the covered seat tests were a 90-percent wool/10-percent nylon blend.

<sup>k</sup>All tests (except for tests 26 and 27 in the 6.1-meter (20.0-foot) section) were conducted in the 17.1-meter (56.0-foot) section.

<sup>l</sup>Provided two shrouded thermocouples in test 26 (to 28).

TABLE II.- CABIN PANEL MATERIALS (BOEING 747-TYPE MATERIALS)

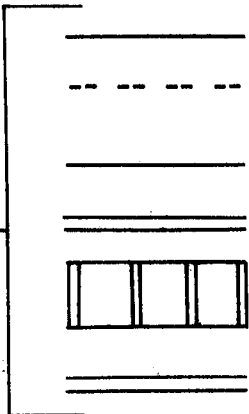
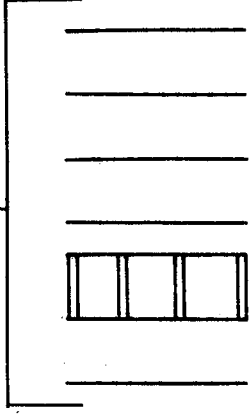
Side wall panel and stowage bin panels	 <p>Polyvinyl fluoride (PVF)</p> <p>-- -- -- -- Ink overprint</p> <p>PVF</p> <p>2-ply, epoxy/Fiberglas prepreg</p> <p>Polyamide honeycomb core</p> <p>2-ply, epoxy/Fiberglas prepreg</p> <p>(Back)</p>
Ceiling panels	 <p>PVF</p> <p>Perforated polyamide paper</p> <p>Dacron fabric</p> <p>1-ply, epoxy/Fiberglas prepreg</p> <p>Polyamide honeycomb core</p> <p>1-ply, epoxy/Fiberglas prepreg</p> <p>(Back)</p>
Passenger Service Unit (PSU) panels	GE Lexan 9600 Polycarbonate

TABLE III.- ORDER OF GRAPHS PRESENTED FOR EACH TEST  
(PLUS INSTRUMENTATION DESIGNATIONS)

<u>Graphs</u>	<u>Instrument designations</u>
<u>Tree temperatures</u>	<u>(T/C's 1 to 42)</u>
T/C tree 1	T/C 1-2-3-4-5-6
T/C tree 2	T/C 7-8-9-10-11-12
T/C tree 3	T/C 13-14-15-16-17-18
T/C tree 4	T/C 19-20-21-22-23-24
T/C tree 5	T/C 25-26-27-28-29-30
T/C tree 6	T/C 31-32-33-34-35-36
T/C tree 7	T/C 37-38-39-40-41-42
<u>Overhead panel temperatures</u>	<u>(T/M's 1 to 30)</u>
PSU	T/M 7-12-13-18-19-24
Stowage bins	T/M 8-11-14-17-20-23
Ceiling panels (aft)	T/M 1-2-3-4-5-6
Ceiling panels (center)	T/M 9-10-15-16-21-22
Ceiling panels (forward)	T/M 25-26-27-28-29-30
<u>Wall panel temperatures</u>	<u>(T/M's 31 to 49)</u>
Side wall panel (top)	T/M 31-32-33-34
Side wall panel (center)	T/M 35-36-37-38-39
Side wall panel (bottom)	T/M 40-41-42-43-44
Side wall panel (rear)	T/M 45-46-47-48-49
<u>Seat cushion temperatures</u>	<u>(T/M's 50 to 63)</u>
Seat cushions (top + bottom)	T/M 50-51-52-61-62-63
Seat cushions (edges)	T/M 53-54-55-56-57-58-59-60
<u>Seat back temperatures</u>	<u>(T/M's 64 to 82)</u>
Seat backs (rear)	T/M 64-65-66-67-68-69
Seat backs (edges)	T/M 70-71-72-73-74-75-76
Seat backs (front)	T/M 77-78-79-80-81-82
<u>Other temperatures</u>	
Above fuel pan	TF HI, TF MID, TF LOW
Inlet + exit	TIN, TEX
Ceiling + floor (trees 1 + 4)	TC4, TC1, TF4, TF1
Shielded vs. unshielded T/C's	TF HI, TF HI-S, TC 13, TC 13-S



TABLE III.- Concluded

<u>Graphs</u>	<u>Instrument designations</u>
<u>Various instrumentation data</u>	
Light transmission	S1-S2-S3-S4-S5-S6
Heat flux, aft	C1-C2-C3
Heat flux, midsection	C4-C5-C6
Air velocity	V1-V2-V3
Fuel weight loss	(NA)
Seat weight loss	(NA)
<u>Gas concentrations</u>	
Hydrogen cyanide concentrations	Usually A8-A16-A8L-F16
Hydrogen fluoride concentrations	Usually A8-A16-A8L-F16
Hydrogen chloride concentrations	Usually A8-A16-A8L-F16
Carbon monoxide concentrations, aft	A8-A16-A8L
Carbon monoxide concentrations, fore	F8-F16-F8L
Carbon dioxide concentrations, aft	(Same)
Carbon dioxide concentrations, fore	(Same)
Oxygen concentrations, aft	(Same)
Oxygen concentrations, fore	(Same)
Hydrocarbons concentrations, aft	(Same)
Hydrocarbons concentrations, fore	(Same)

TABLE IV.- TEST GRAPHS PROVIDED

Test No.	Cabin materials	Temperatures									Other data						
		T/C tree	Head panel	Wall panel	Seat cushion	Seat back	Fuel pan	Inlet + exit	Ceiling + floor	Shielded	Light transmission	Heat flux	Air velocity	Fuel weight loss	Seat weight loss	Wet gas	Dry gas
1	None - fuel only	X					X	X			X	X					X
2	None - fuel only	X					X	X			X	X					X
3	None - fuel only	X					X	X			X	X					X
4	None - fuel only	X					X	X			X	X		X			X
5	None - fuel only	X					X	X			X	X		X			X
6	None - fuel only	X					X	X			X	X		X			X
10	None - fuel only																X
11	None - fuel only	X					X	X	X		X	X	X	X			
12	Seats (cushions)	X			X		X	X	X		X	X	X	X	X	X	X
13	Seats (backs)	X				X	X	X	X		X	X	X	X	X	X	X
14	Seats (cushions)	X			X		X	X	X		X	X	X	X	X	X	X
15	Seats	X			X	X	X	X	X		X	X	X	X	X	X	X
16	Seats (Upjohn)	X			X	X	X	X	X		X	X	X	X	X	X	X
17	Seats	X			X	X	X	X	X		X	X	X	X	X	X	X
18	Seats (polyimide)	X			X	X	X	X	X		X	X	X	X		X	X
19	Wall panel	X		X			X	X	X		X	X	X	X		X	X
20	Overhead panels	X	X				X	X	X		X	X	X	X			X
21	Overhead panels	X	X				X	X	X		X	X	X	X		X	X
22	None - fuel only	X					X	X	X		X	X	X	X			X
23	All panels	X	X	X			X	X	X		X	X	X	X		X	X
24	Seats and all panels	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
25	Seats	X			X	X	X	X	X		X	X	X	X	X	X	X
26	None - fuel only	X					X	X	X	X	X	X		X			X
27	None - fuel only	X					X	X	X	X	X	X		X			X
28	Seats and all panels	X	X	X	X	X	X	X	X	X	X	X	X			X	X

TABLE V.- OUTSIDE AIR PRESSURE, TEMPERATURE, AND HUMIDITY

Test No.	Barometric pressure, mmHg	Temperature, °C (°F)		Relative humidity, percent
1	-	-	-	-
2	764	30	(86)	76
3	764	31	(88)	74
4	762	24	(75)	98
5	758	31	(88)	77
6	760	29	(84)	80
10	760	22	(72)	90
11	761	17	(63)	68
12	765	21	(70)	78
13	761	21	(70)	81
14	763	22	(72)	79
15	762	17	(63)	73
16	747	24	(75)	90
17	761	23	(73)	100
18	768	30	(86)	70
19	759	31	(88)	74
20	753	26	(79)	91
21	761	30	(86)	80
22	762	27	(81)	79
23	759	24	(75)	86
24	757	28	(82)	88
25	763	18	(64)	78
26	759	21	(70)	60
27	758	20	(68)	80
28	770	11	(52)	68

TABLE VI.- PRE-TEST AIR VELOCITY MEASUREMENTS

Test No.	Outside wind		Av velocity - natural vent <sup>b,c</sup> , m/min (ft/min)		Av velocity - forced vent <sup>b,d</sup> , m/min (ft/min)	
	Av velocity, kph (mph)	Av direction <sup>a</sup> , deg	At V1	At V2	At V1	At V2
1 to 13	These measurements were not taken for tests 1 to 13.					
14	27 (17)	150	53 (175)	61 (200)	61 (200)	61 (200)
15	22 (14)	300	12 (40)	9 (30)	47 (155)	41 (135)
16	29 (18)	160	27 (90)	38 (125)	35 (115)	30 (100)
17	11 ( 7)	160	61 (200)	33 (110)	-- --	-- --
18	5 ( 3)	120	12 (40)	12 (40)	36 (120)	36 (120)
19	2 ( 1)	360	0 (0)	0 (0)	43 (140)	43 (140)
20	-- --	--	-- --	-- --	-- --	-- --
21	10 ( 6)	150	61 (200)	91 (300)	8 (25)	8 (25)
22	5 ( 3)	340	0 (0)	0 (0)	35 (115)	35 (115)
23	2 ( 1)	210	0 (0)	0 (0)	8 (25)	6 (20)
24	8 ( 5)	45	35 (115)	35 (115)	6 (20)	8 (25)
25	8 ( 5)	110	0 (0)	0 (0)	15 (50)	15 (50)
26	-- --	--	-- --	-- --	-- --	-- --
27	10 ( 6)	120	26 (85)	33 (110)	18 (60)	18 (60)
28	-- --	--	-- --	-- --	-- --	-- --

<sup>a</sup>The azimuth of the forward fuselage centerline was 340°.

<sup>b</sup>These measurements were made next to air velocity probes (V1 and V2) in aft bulkhead doorway, using handheld anemometers.

<sup>c</sup>Both forward and aft fuselage doors were open.

<sup>d</sup>Blower was on, forward door was closed, and aft door was open.

TABLE VII.- MAXIMUM GAS CONCENTRATIONS DETECTED

Test No.	Cabin materials	Cyanide (as HCN), ppm	Fluoride (as HF), ppm	Chloride (as HCl), ppm	Carbon monoxide, ppm	Carbon dioxide, percent	Minimum oxygen, percent	Hydrocarbons <sup>a</sup> (as CH <sub>4</sub> ), ppm
1	None - fuel only	<12	<12	<24	436	1.95	17.8	--
2	None - fuel only	<12	<12	<24	517	2.09	17.8	--
3	None - fuel only	<12	<12	<24	401	1.50	18.5	--
4	None - fuel only	<12	<12	<24	466	1.56	18.4	--
5	None - fuel only	<12	<12	<24	406	1.46	18.2	--
6	None - fuel only	<12	<12	<24	468	1.43	18.9	--
10 <sup>b</sup>	None - fuel only	<6	<6	<12	489	1.97	18.2	198
11	None - fuel only	<6	<6	<12	54	.35	20.7	29
12	Seats (cushions only)	144	<6	306	1679	1.24	19.4	938
13 <sup>c</sup>	Seats (backs only)	51	<3	111	739	1.21	19.6	213
14	Seats (cushions only)	132	<3	231	1604	1.25	19.5	859
15	Seats	165	<3	570	3209	2.33	18.5	1200
16	Seats (Upjohn)	180	<3	<6	1574	1.97	18.7	731
17	Seats	330	<3	720	3359	2.22	18.5	2006
18	Seats (polyimide)	6	<3	<6	294	.46	20.2	189
19	Wall panel	11	105	20	1134	1.34	19.1	466
20	Overhead panels	<3	<3	<6	319	1.15	19.3	129
21	Overhead panels	<3	33	20	989	2.14	18.0	394
22	None - fuel only	<3	<3	<6	--	.42	20.5	--
23	Wall and overhead panels	21	177	87	2664	3.01	15.9	1736
24	Seats, wall, and overhead panels	420	480	2580	8269	4.52	14.8	4651
25	Seats	420	57	1770	5389	4.26	15.6	1644
26	None - fuel only	<3	<3	<6	604	3.53	15.4	304
27	None - fuel only	<3	<3	<6	--	.92	19.6	89
28	Seats, wall, and overhead panels	1230	780	2040	11 500	9.69	9.6	7339

<sup>a</sup>Hydrocarbon concentrations include only light hydrocarbons up to C<sub>6</sub>. Concentrations are in methane (CH<sub>4</sub>) equivalents.

<sup>b</sup>Test 10 was the first test in which a real-time dry gas collection and analyzer system (for CO-CO<sub>2</sub>-O<sub>2</sub>-HC) was available to cover six dry gas ports. Previous tests were limited to 32-liter (8-gallon) gas samples from only two dry gas ports.

<sup>c</sup>Test 13 was the first test in which wet gas collection system (for HCN-HF-HCl) was upgraded to cover four wet gas ports. Previous tests were limited to only two wet gas ports.

TABLE VIII.- SEAT AND WALL PANEL WEIGHT LOSS

Test No.	Cabin materials	Three foam seats		Wall panel	
		Pre-test weight, kg (lb)	Weight loss, percent	Pre-test weight, kg (lb)	Weight loss, percent
1 to 11	None - fuel only	NA		NA	
12	Seats (cushions only)	4.0 (8.8)	48		NA
13	Seats (backs only)	1.8 (4.0)	83		NA
14	Seats (cushions only)	4.0 (8.8)	80		NA
15	Seats	5.8 (12.7)	83		NA
16	Seats (Upjohn)	5.9 (12.8)	70		NA
17	Seats	-- <sup>a</sup>	--		NA
18	Seats (polyimide)	--	--		NA
19	Wall panel		NA	3.1 (6.9)	16
20	Overhead panels		NA		NA
21	Overhead panels		NA		NA
22	None - fuel only		NA		NA
23	Wall and overhead panels		NA	3.1 (6.9)	35
24	Seats, wall, and overhead panels	--	--	3.0 (6.6)	52
25	Seats	--	--		NA
26	None - fuel only		NA		NA
27	None - fuel only		NA		NA
28	Seats, wall, and overhead panels	--	--	--	--

<sup>a</sup>A dash (--) symbol implies that the data were not taken, were lost, or were otherwise not available.

TABLE IX.- OVERHEAD PANEL WEIGHT LOSS<sup>a</sup>

Test No.	No. 1 ceiling panel	No. 2 ceiling panel	No. 3 PSU	No. 4 stowage bin	No. 5 ceiling panel	No. 6 stowage bin	No. 7 PSU	No. 8 ceiling panel	No. 9 ceiling panel	All nine overhead panels
Weight loss, percent										
1 to 19	No overhead panels were used in these tests									
20	(All panels had less than 2 percent weight loss)									<2
21			34	(All other panels had less than 2 percent weight loss)						4
22	No overhead panels were used in this test									
23	2	4	71	33	8	5	3	4	2	13
24	20	20	81	57	54	29	32	14	6	33
25 to 27	No overhead panels were used in these tests									
28	(Data were not available)									--
Average pre-test panel weights, kg (lb)										
	2.3 (5.0)	2.3 (5.0)	1.9 (4.2)	1.0 (2.2)	2.3 (5.0)	1.0 (2.2)	1.9 (4.2)	2.3 (5.0)	2.3 (5.0)	17.1 (37.8)

<sup>a</sup>Refer to figure 7 for locations of panels.

## CONFIGURATION OF TEST INSTRUMENTATION



PART A

OVERALL CONFIGURATION AND IDENTIFICATION OF INSTRUMENTATION

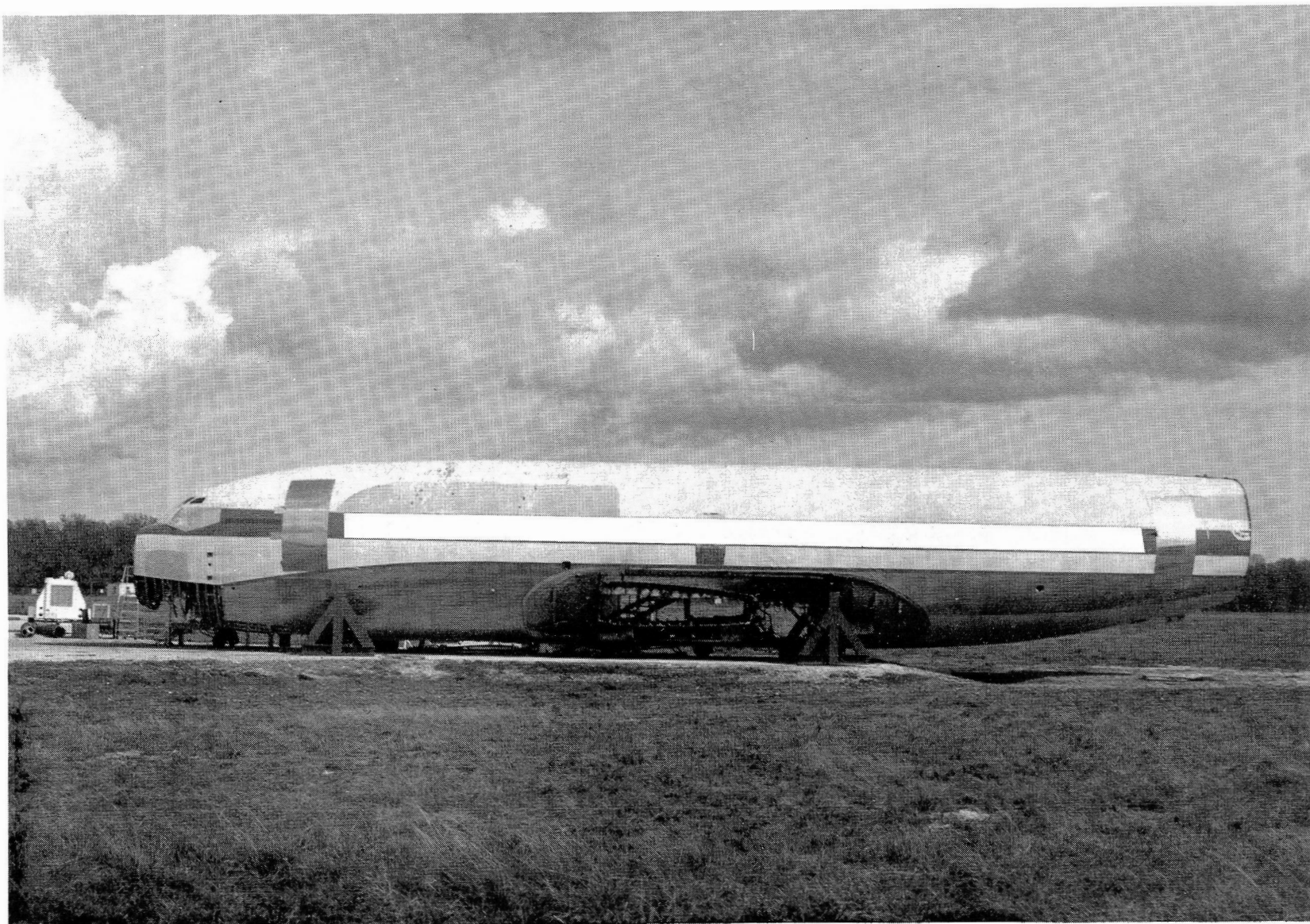
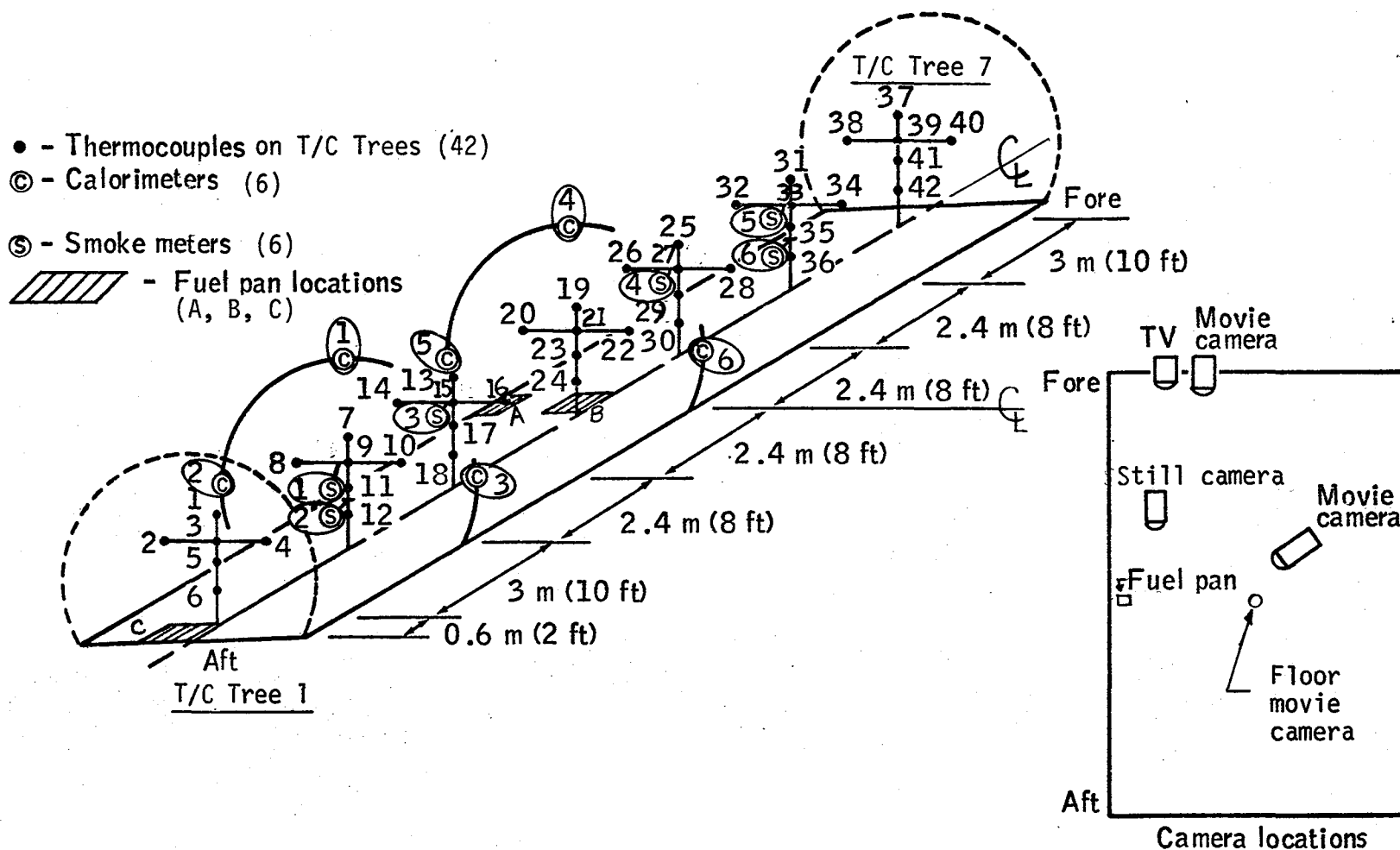
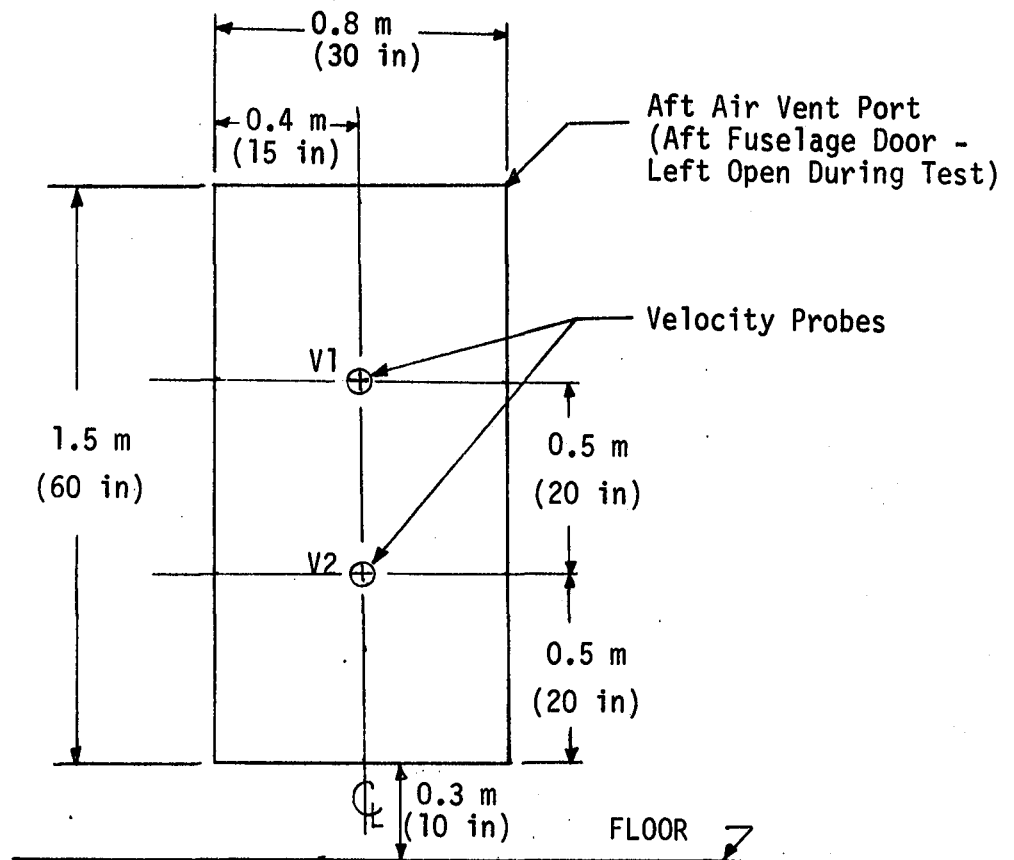


Figure 1 . - Boeing 737 Fuselage Test Section



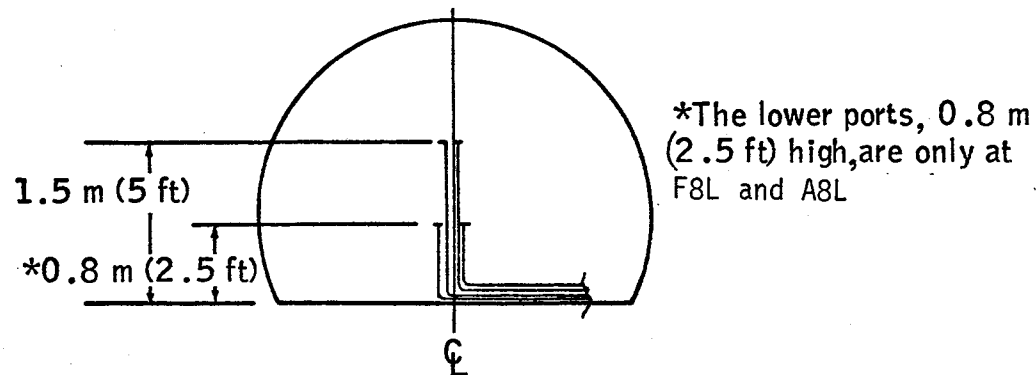
\*Other instrumentation (not included here)  
are shown in the schematics which follow.

Figure 2. - Overall Configuration of Tree T/C's, Calorimeters, Smoke Meters, Fuel Pans, and Cameras\*



Velocity Probe V3 was located 3 cm (1 in) from ceiling at T/C Tree 5.

Figure 3. - Air Velocity Probes



Side View

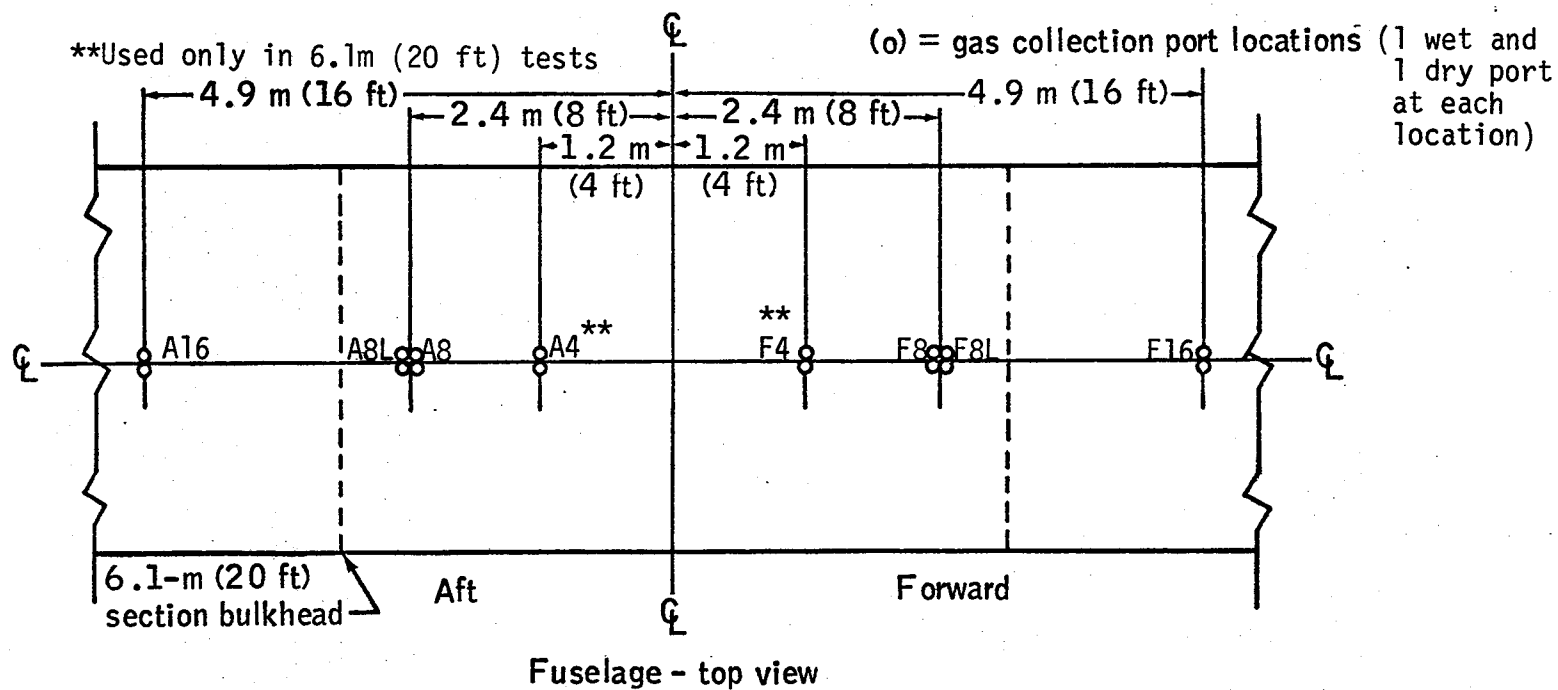


Figure 4. - Gas Collection Ports

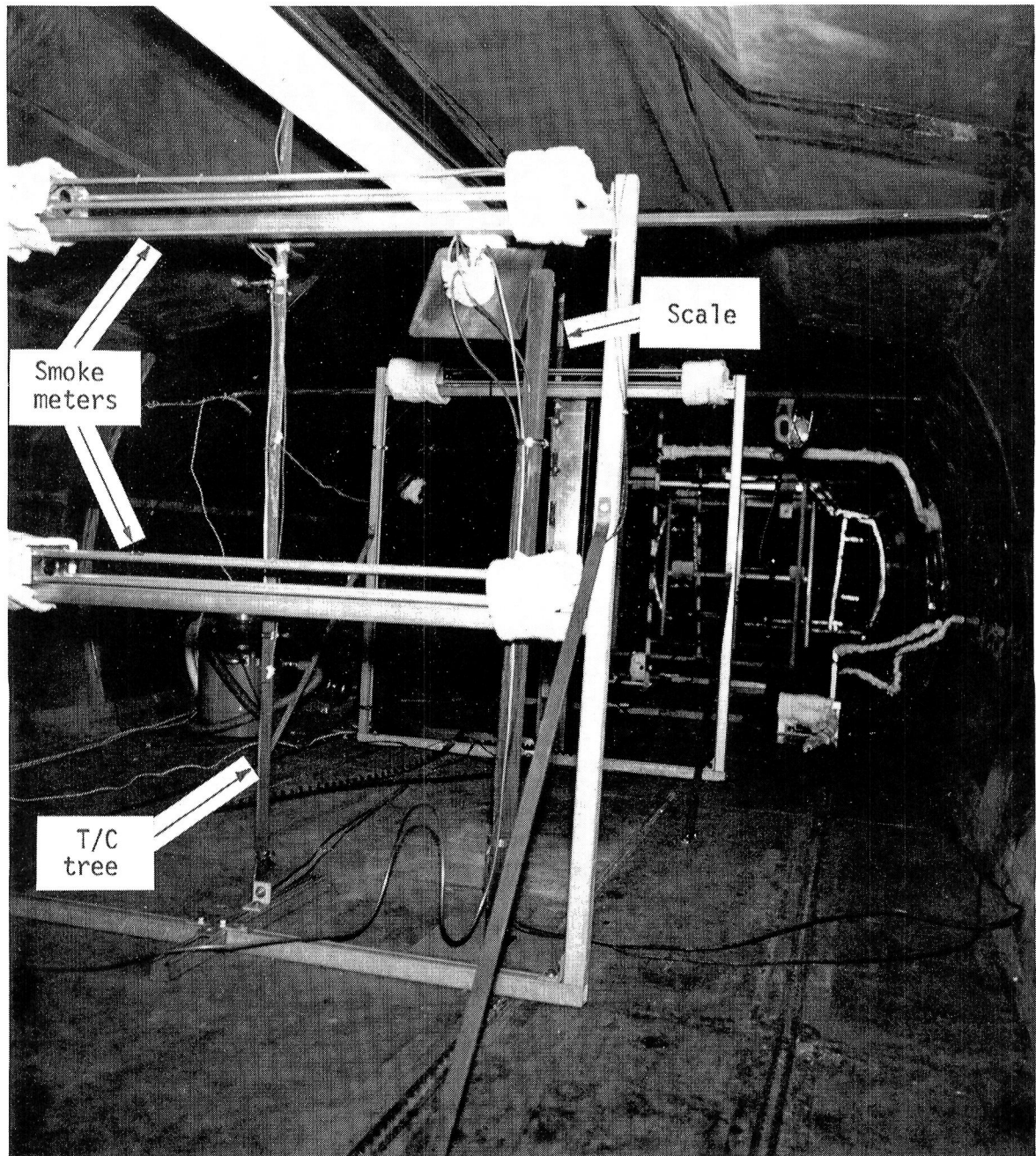


Figure 5 . - Fuselage Instrumentation (View Facing Aft)



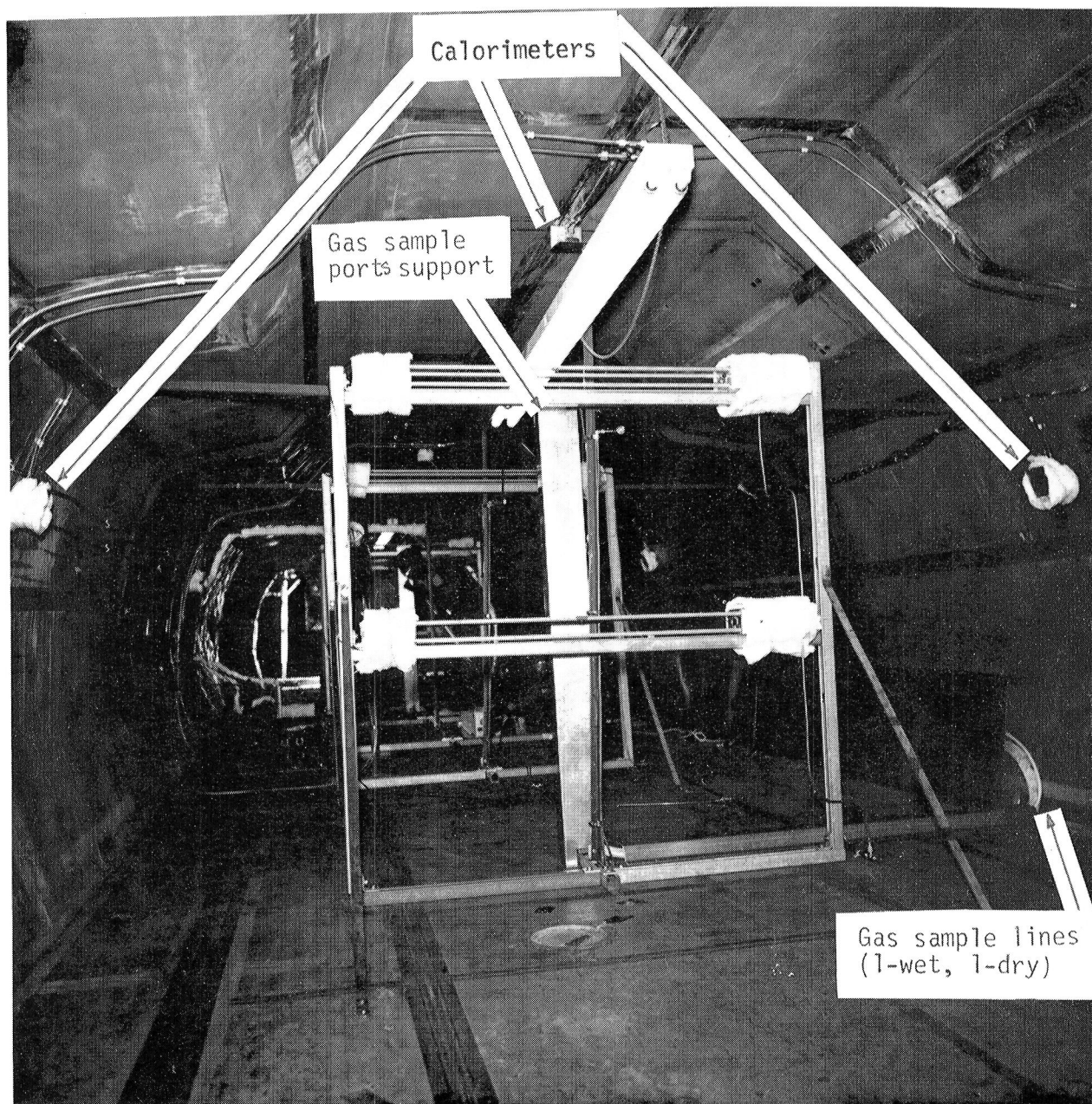
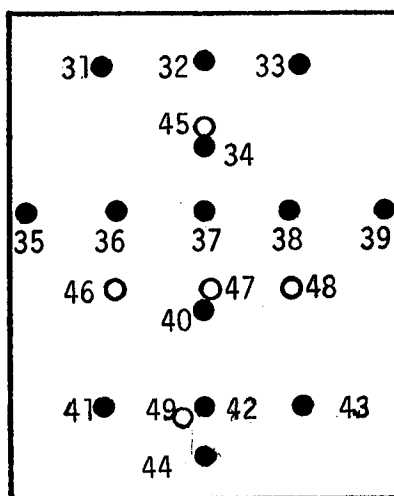
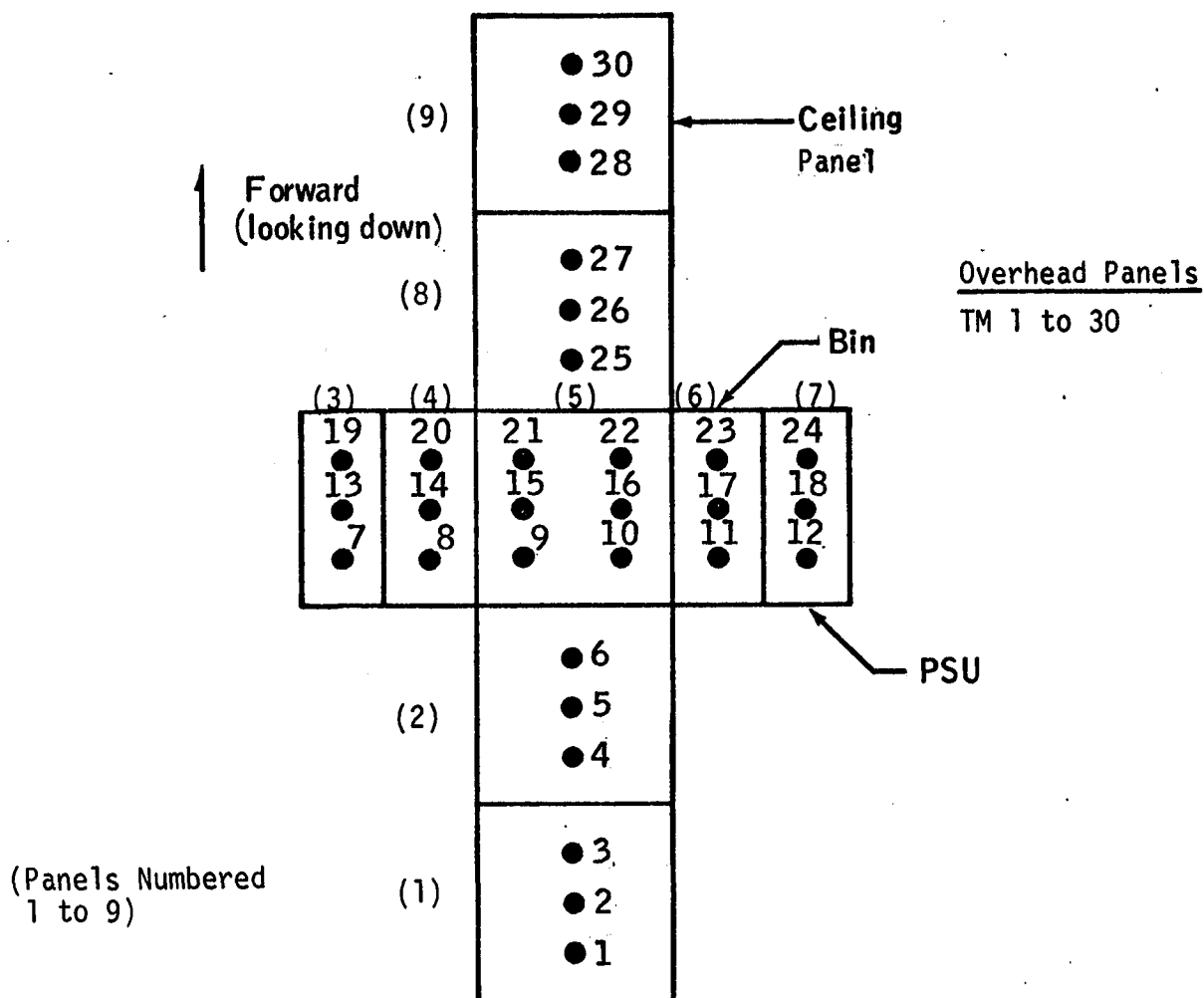


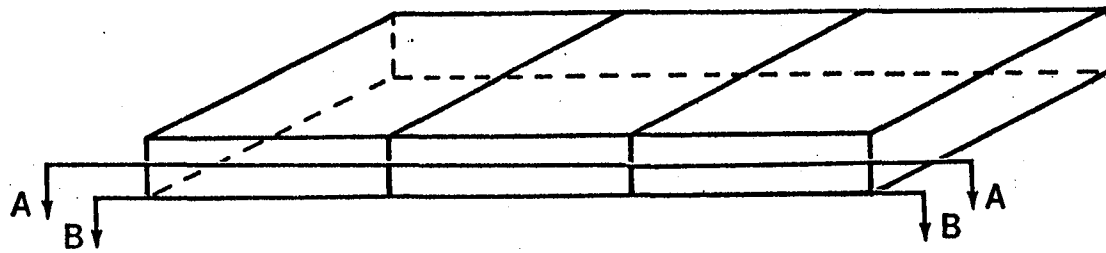
Figure 6 . - Fuselage Instrumentation (View Facing Forward)



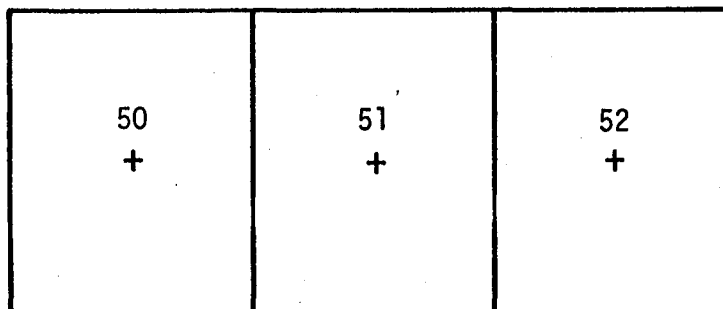
Wall Panel  
TM 31 to 49

Figure 7. - Overhead and Wall Panel T/C's



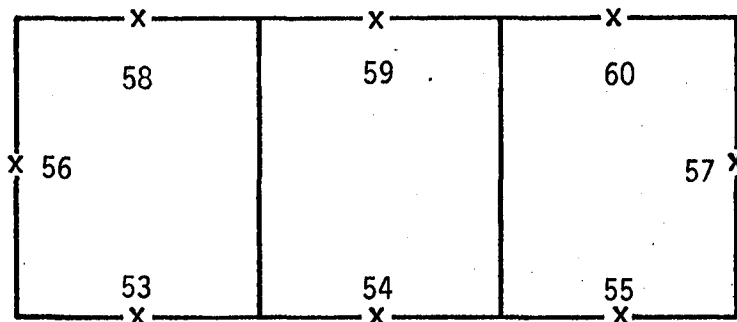


Top



TM 50 to 63

A-A



B-B

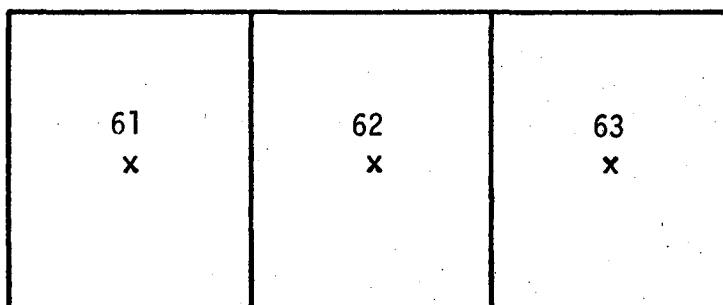
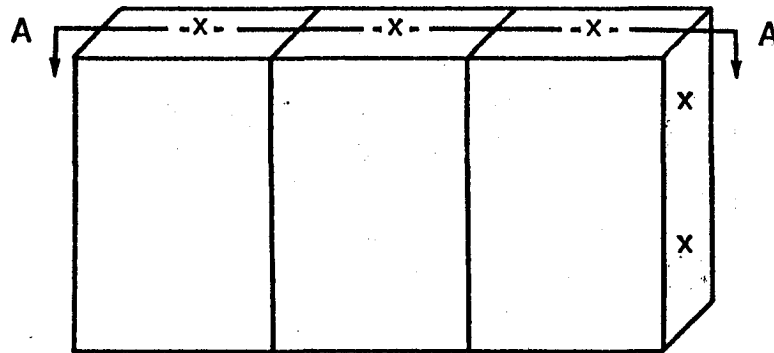


Figure 8. - Seat Cushion T/C's



Rear

64 x	65 x	66 x
x 67	x 68	x 69

A - A

x 70	x 71	x 72
x 73		74 x
x 75		76 x

TM 64 to 82

Front

79 x	78 x	77 x
x 82	x 81	x 80

Figure 9. - Seat Back T/C's

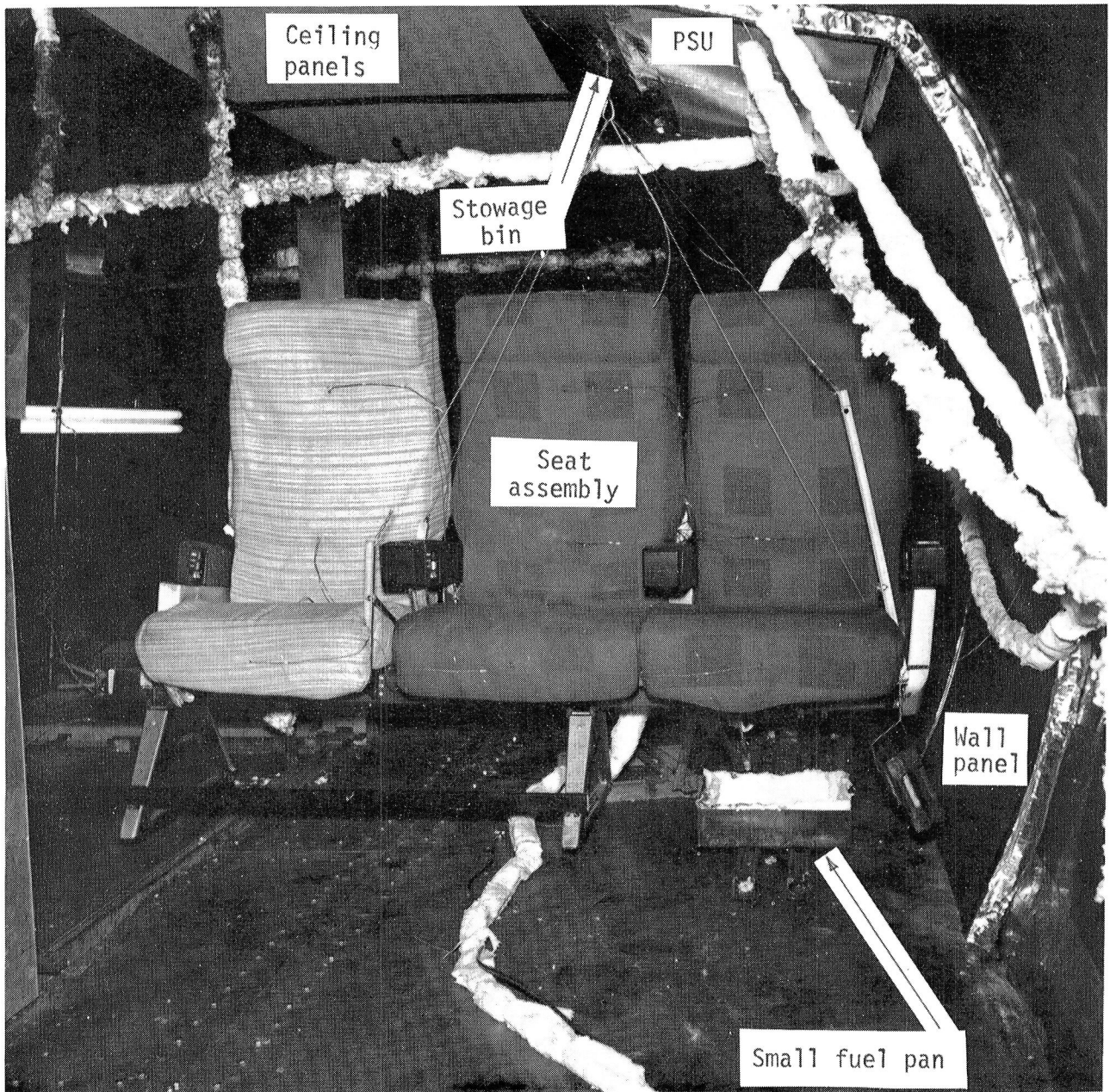


Figure 10 . - Full-up Cabin Materials Configuration (Seats, and Wall, PSU, Bin, and Ceiling Panels)

- Notes: (1) In tests 1 to 6, there was only 1 T/C, about 15 cm (6 in) above fuel pan.
- (2) In most tests, 3 T/C's were over center of fuel pan. In seat tests, due to obstruction by seats, T/C's were positioned as close to fuel pan as practical.

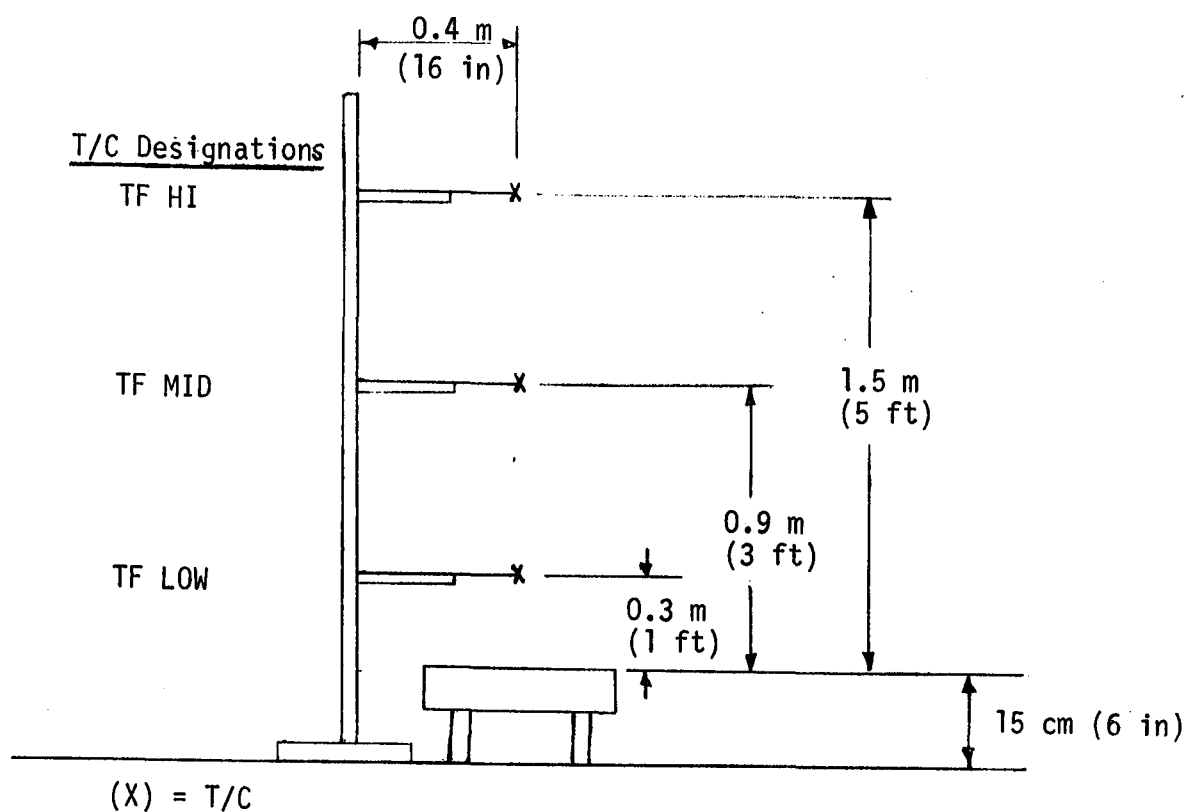


Figure 11. - Fuel Pan T/C's

INSTRUMENT DESIGNATIONSLOCATIONSa) Inlet and Exit T/C's  
(Installed in all tests)

$T_{IN}$	Inlet air T/C located near center of air inlet diffuser on forward bulkhead door
$T_{EX}$	Exit air T/C located near center of aft bulkhead doorway

b) Ceiling and Floor T/C's  
(Installed after Test 6)

TC4	3 cm (1 in) from ceiling at T/C Tree 4
TC1	3 cm (1 in) from ceiling at T/C Tree 1
TE4	3 cm (1 in) from floor at T/C Tree 4
TF1	3 cm (1 in) from floor at T/C Tree 1

c) Shielded vs. Unshielded T/C's  
(Shielded T/C's were only installed in Tests 26 thru 28)

TF HI	Unshielded (High) Fuel Pan T/C
TF HI-S	Shielded (High) Fuel Pan T/C
TC 13	Unshielded T/C 13 (on Tree 3)
TC 13-S	Shielded T/C 13 (on Tree 3)

Figure 12. - Other T/C's

PART B

GAS COLLECTION AND ANALYSIS SYSTEMS

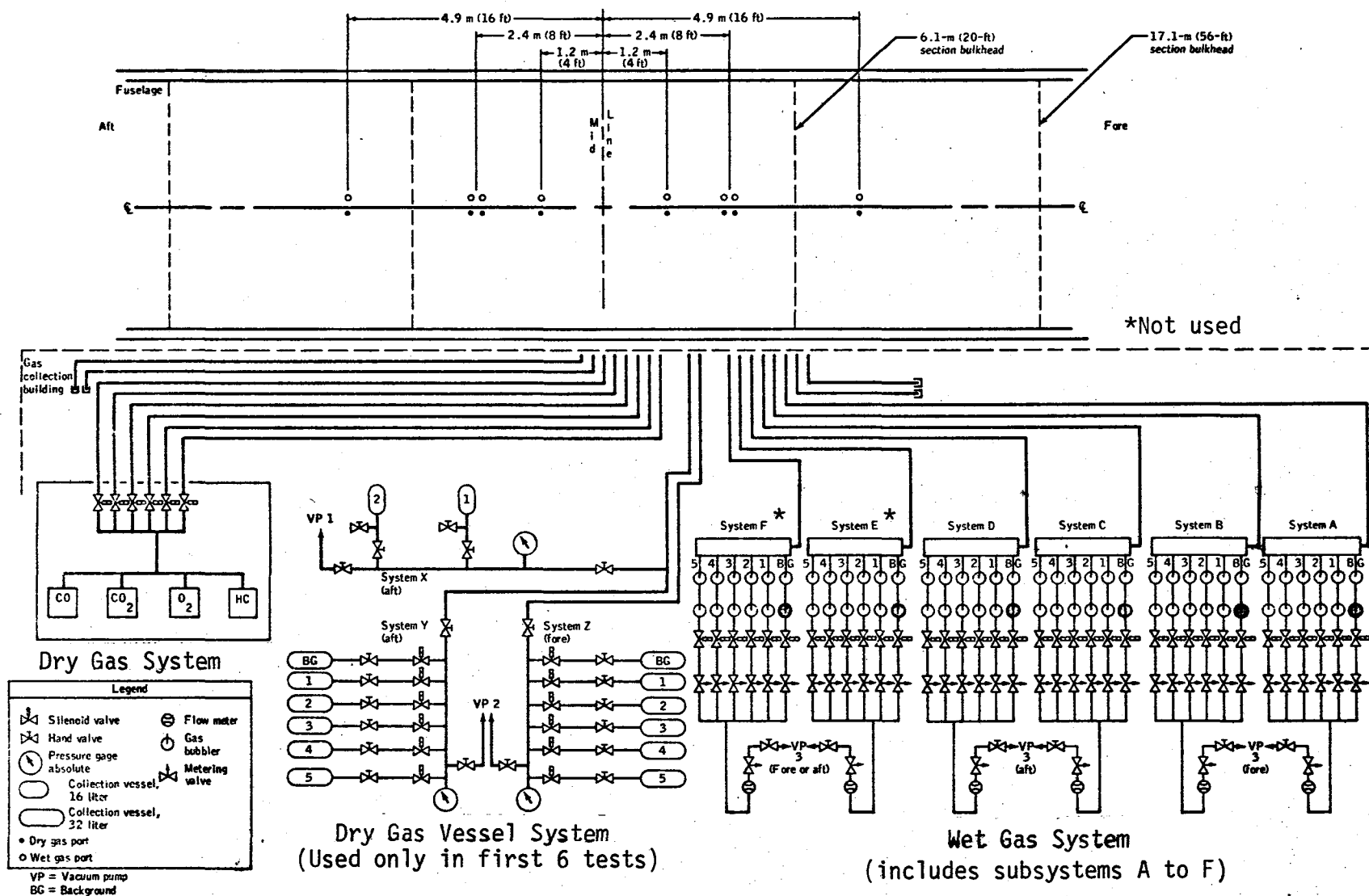


Figure 13. - Overall Configuration of Gas Collection Systems

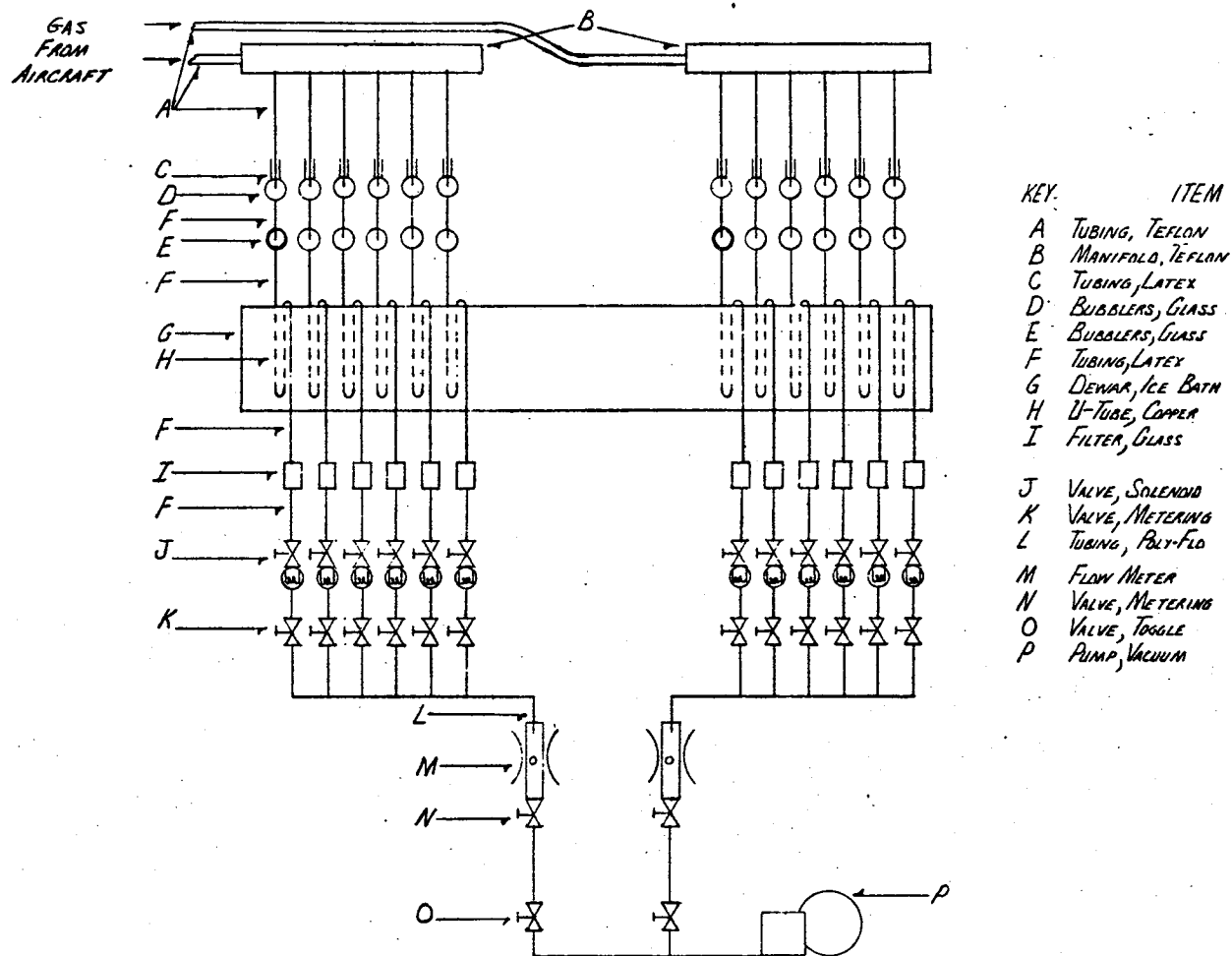


Figure 14. - Components of Wet Gas Collection System (50% of total system shown)



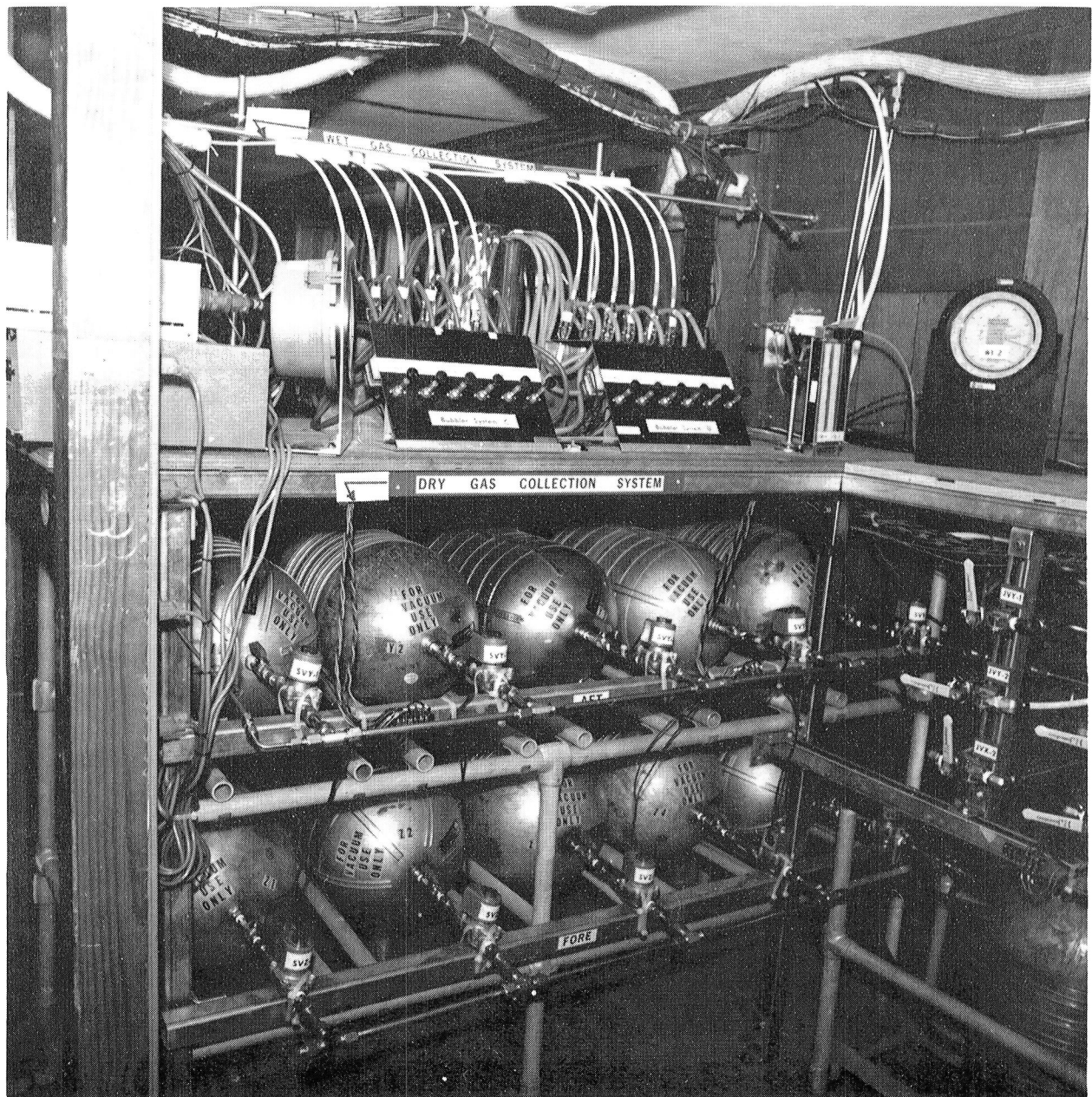


Figure 15 . - Wet Gas Collection System (Plus Early\* Dry Gas) Collection System)

\*(Dry gas system shown was used only for first 6 tests)

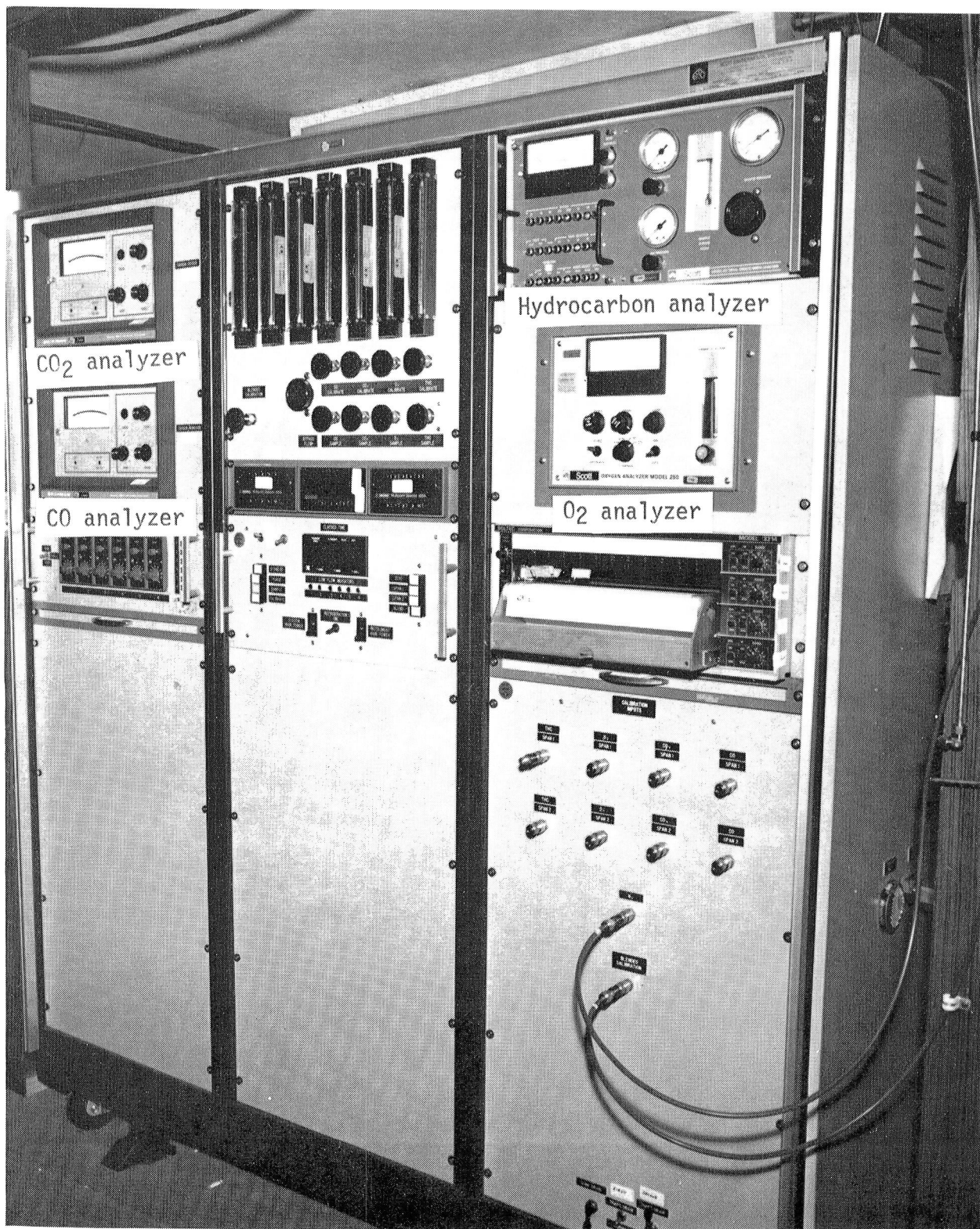


Figure 16 . - Dry Gas Collection and Analysis System Console

PART C

ADDITIONAL THERMOCOUPLE DETAILS

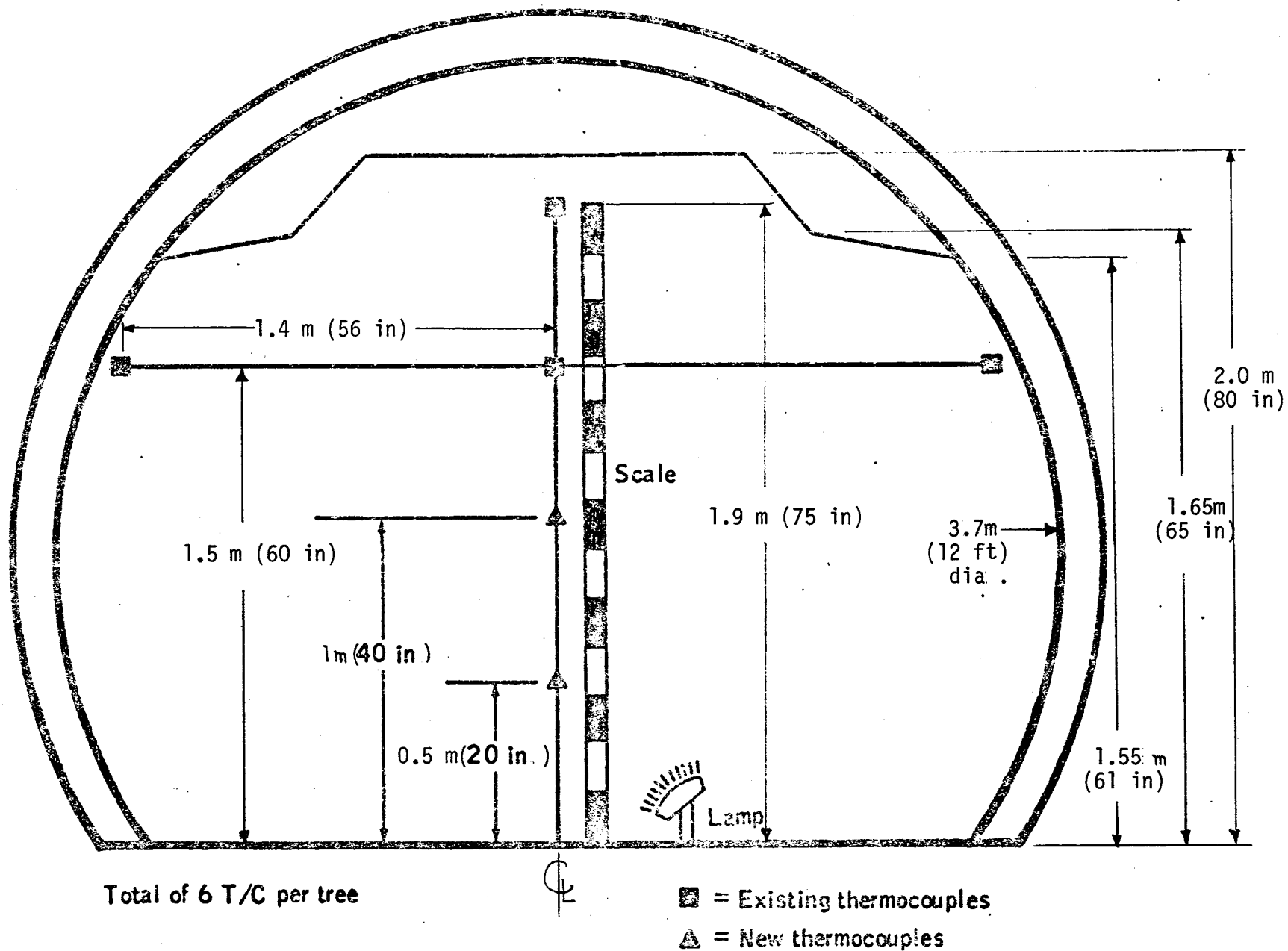
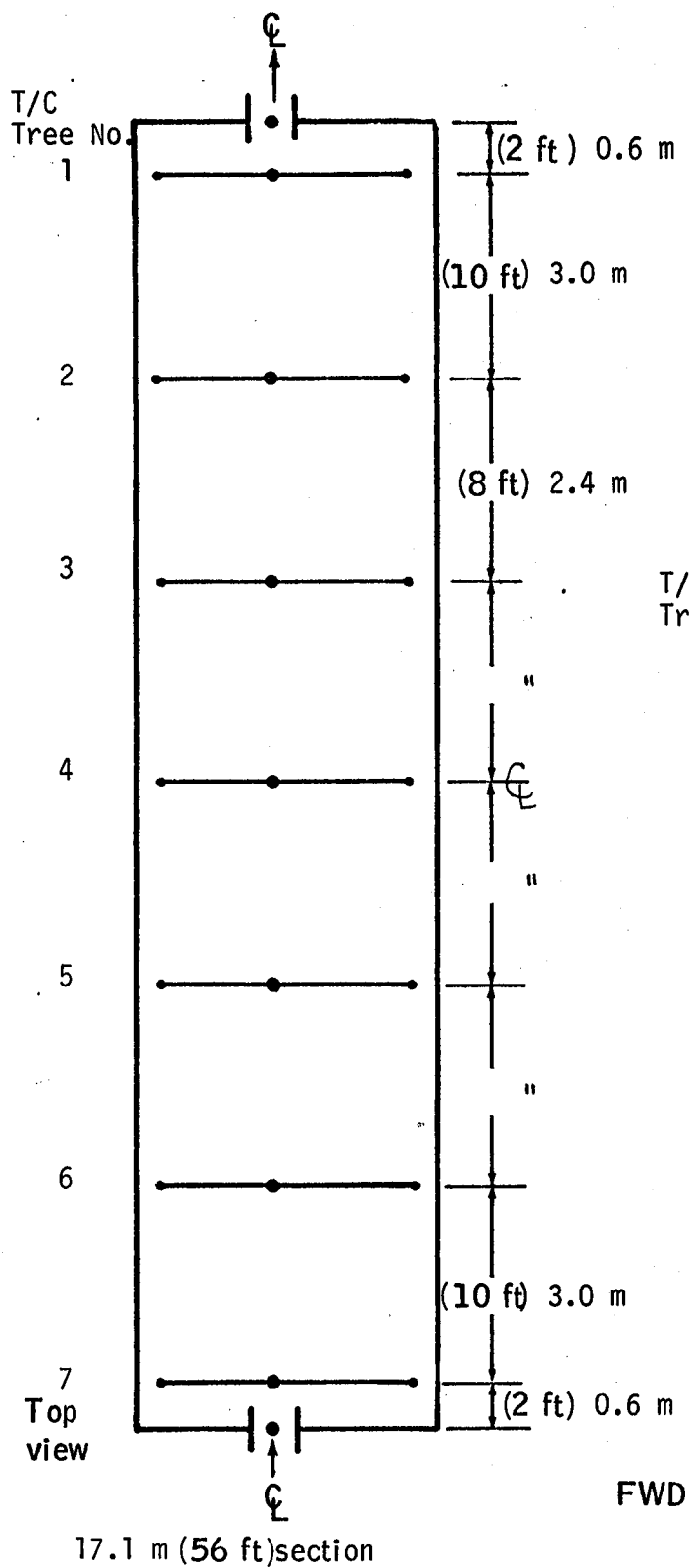


Figure 17. - Thermocouple Tree T/C Locations (and Overhead Panel Heights)



FWD

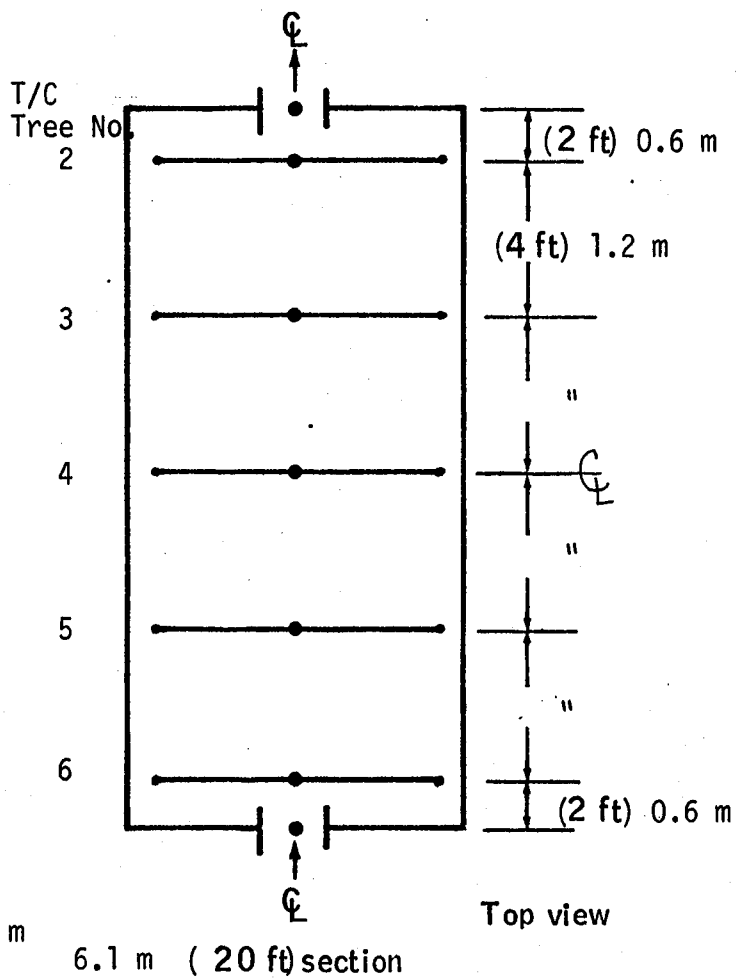


Figure 18. - Thermocouple Tree Locations

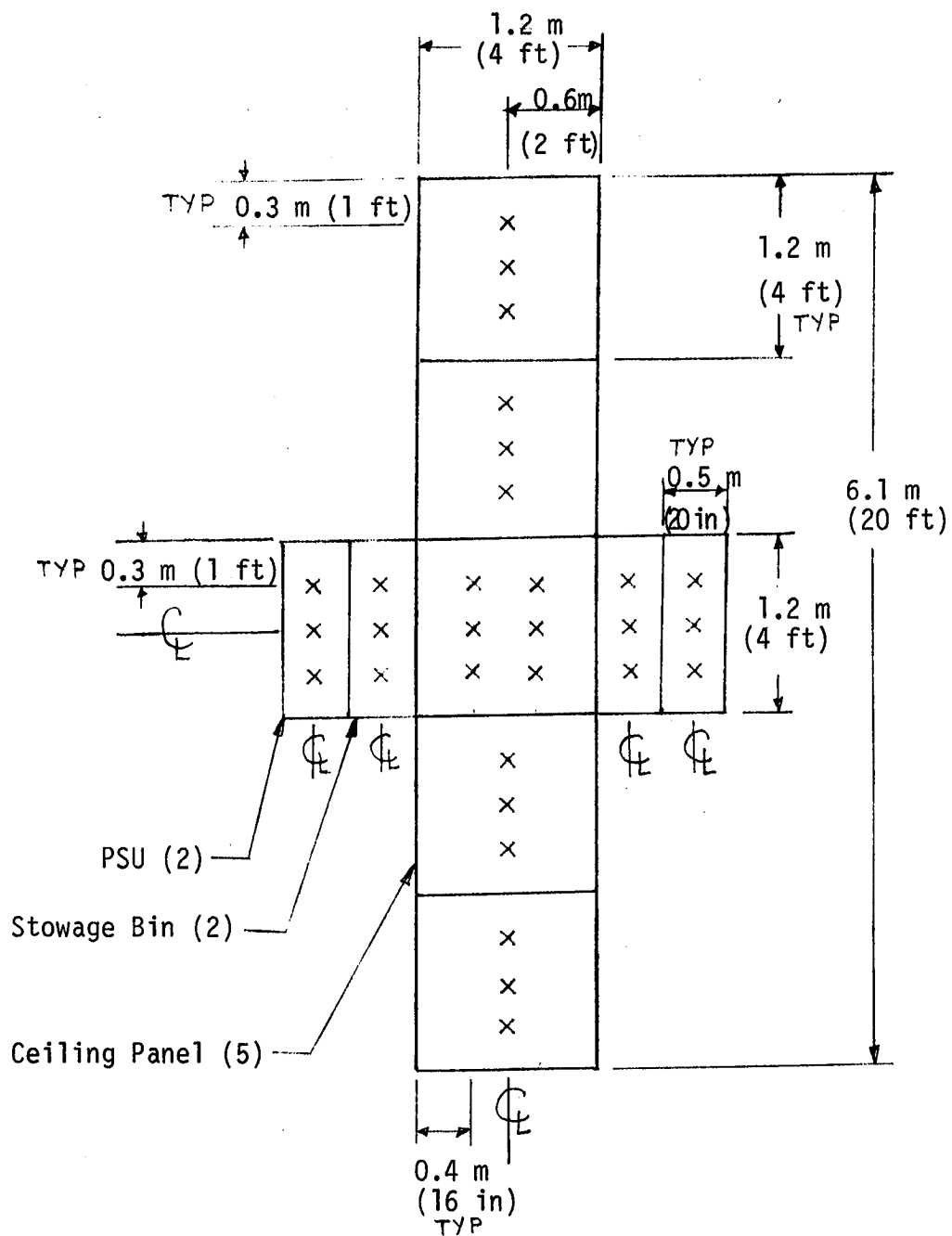


Figure 19. - Overhead Panel T/C Locations

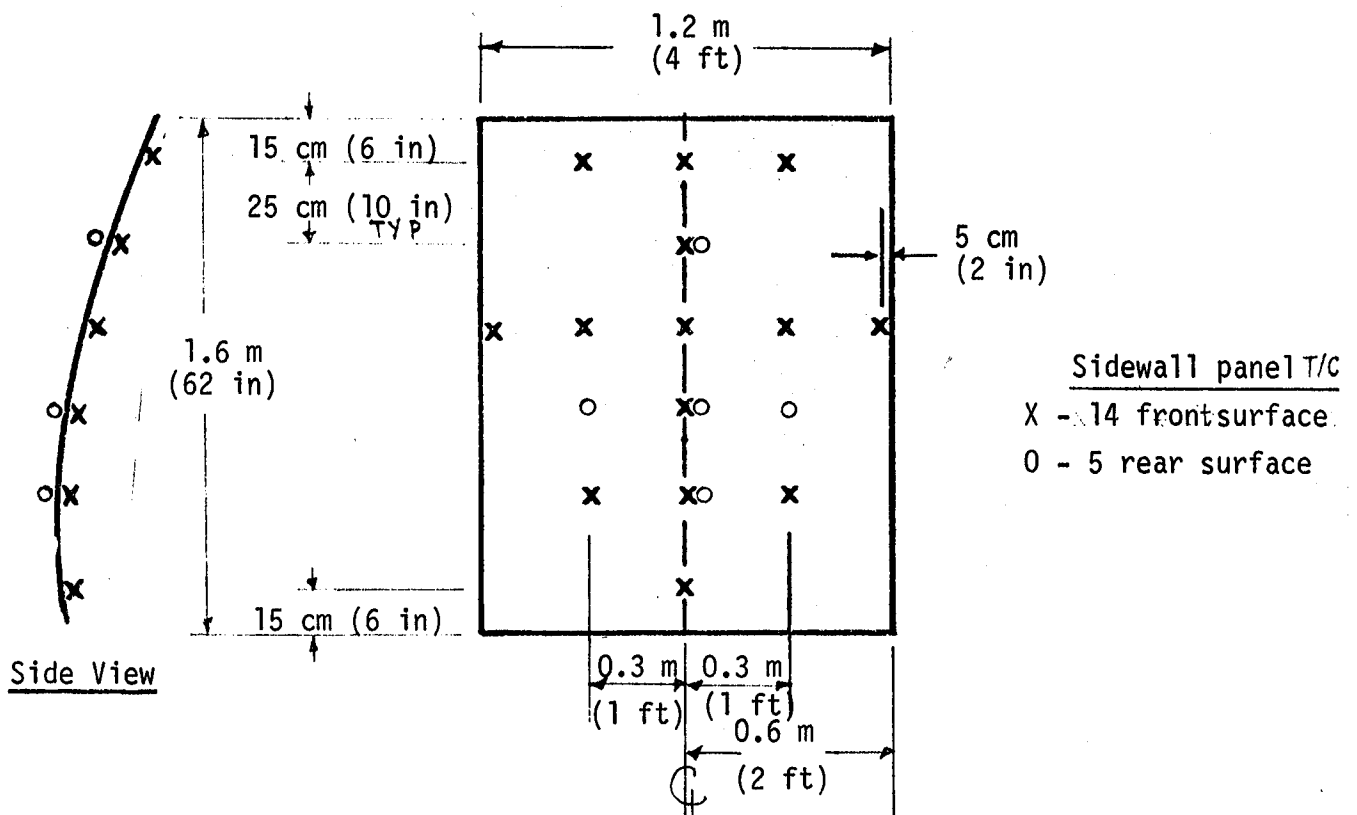


Figure 20. - Wall Panel T/C Locations

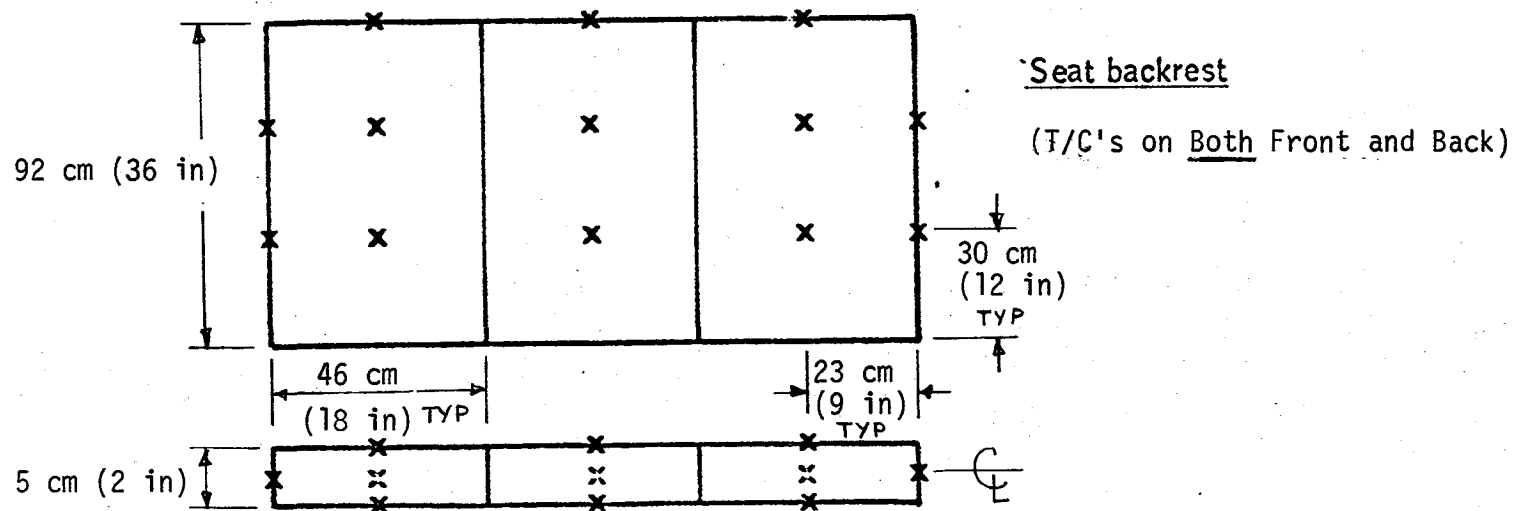
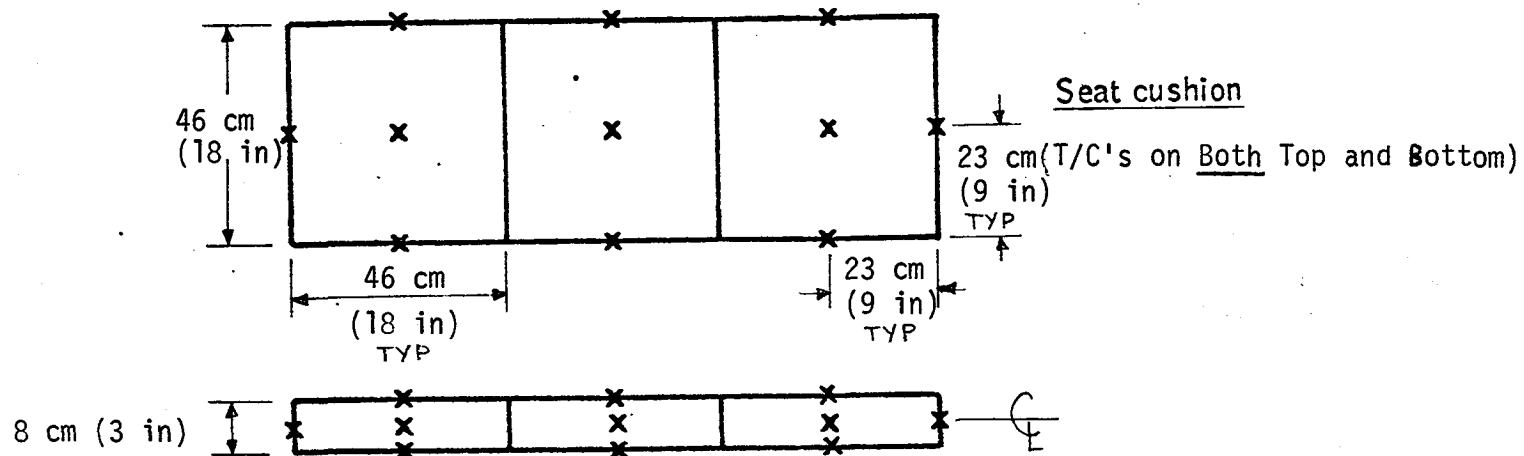


Figure 21. - Seat Cushion and Back T/C Locations



PART D

ADDITIONAL DETAILS — OTHER INSTRUMENTATION

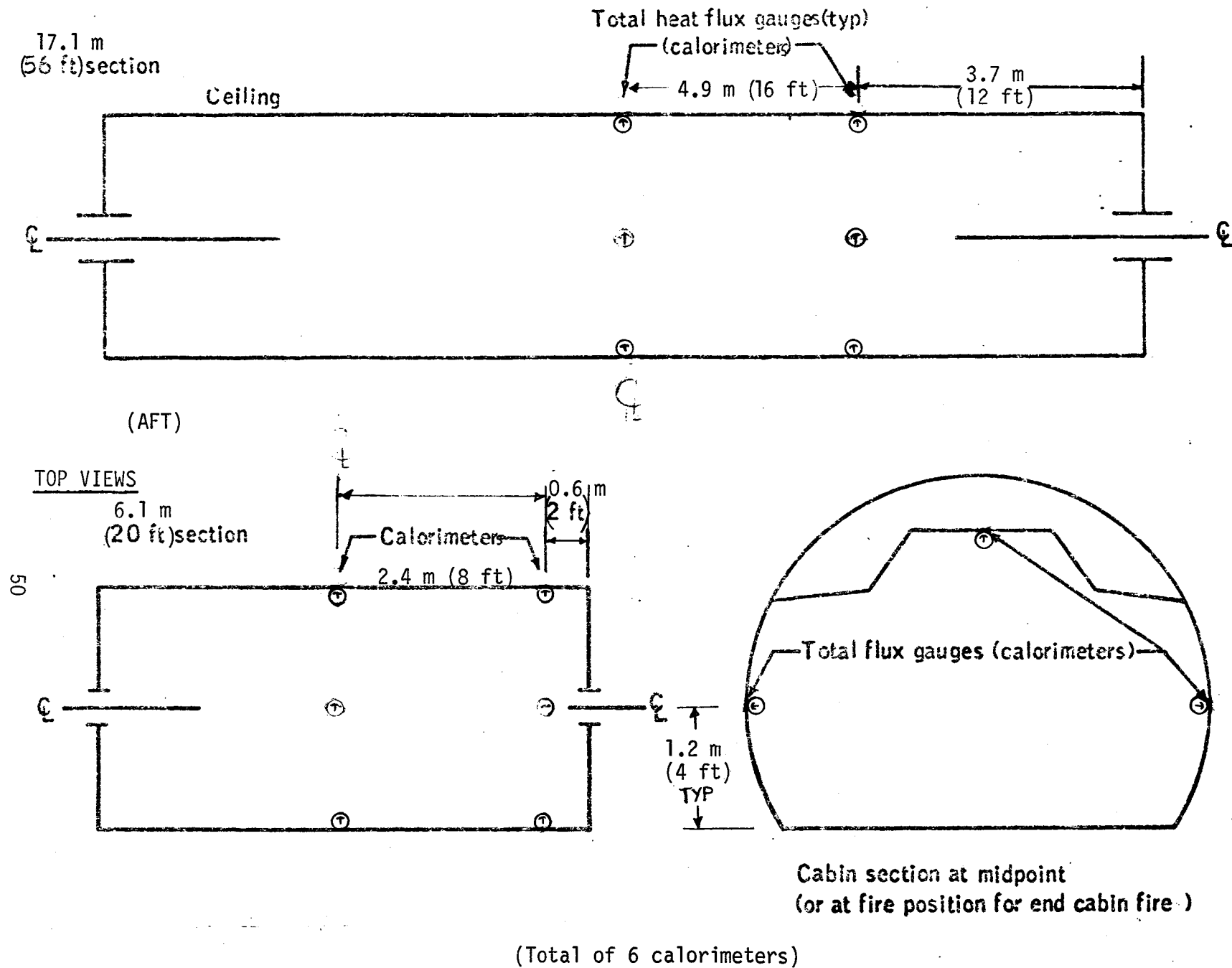
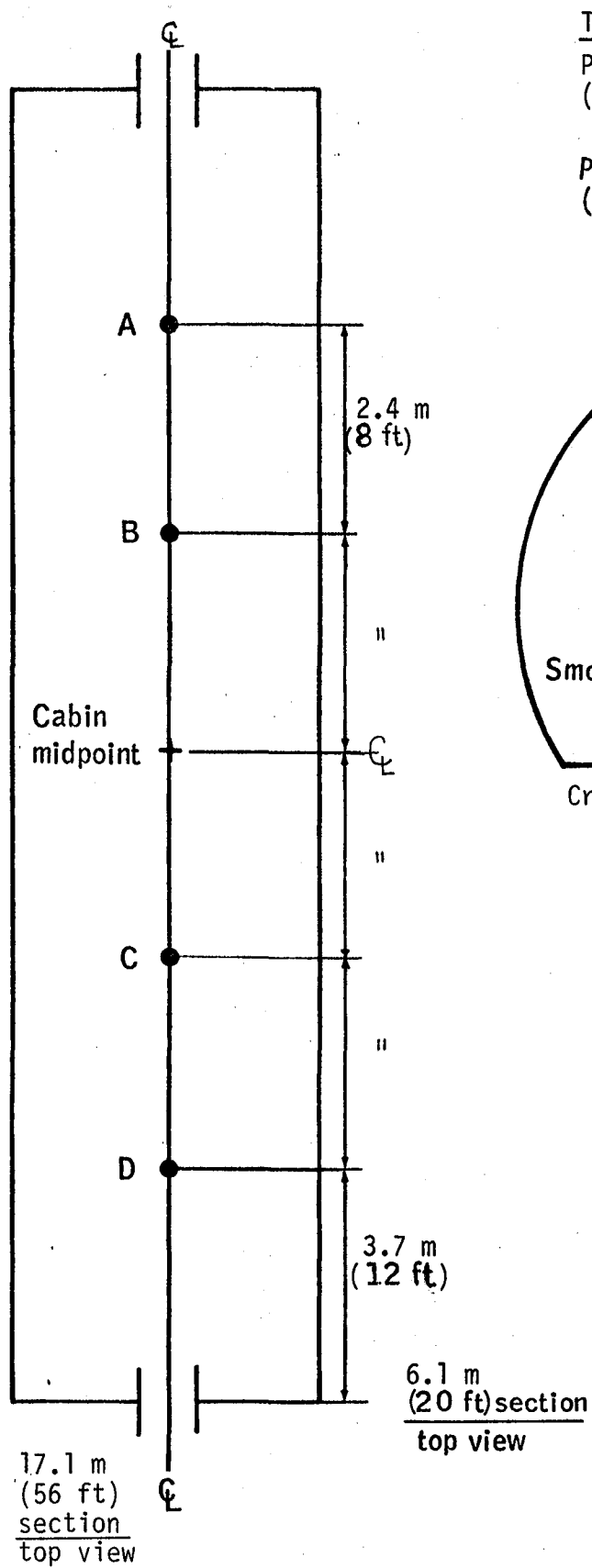


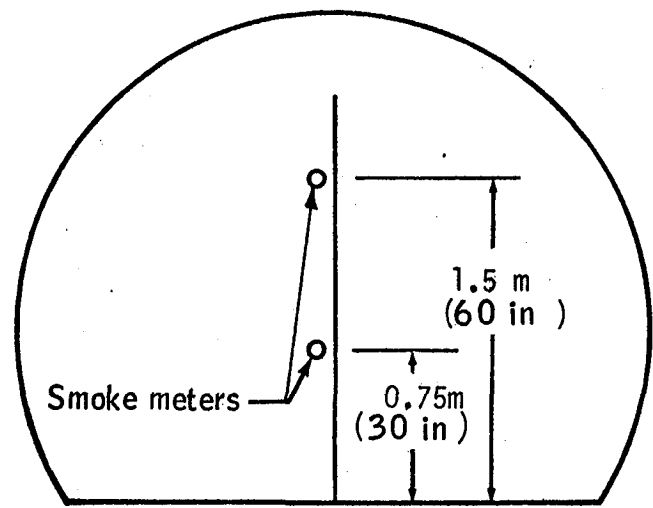
Figure 22. - Calorimeter Locations



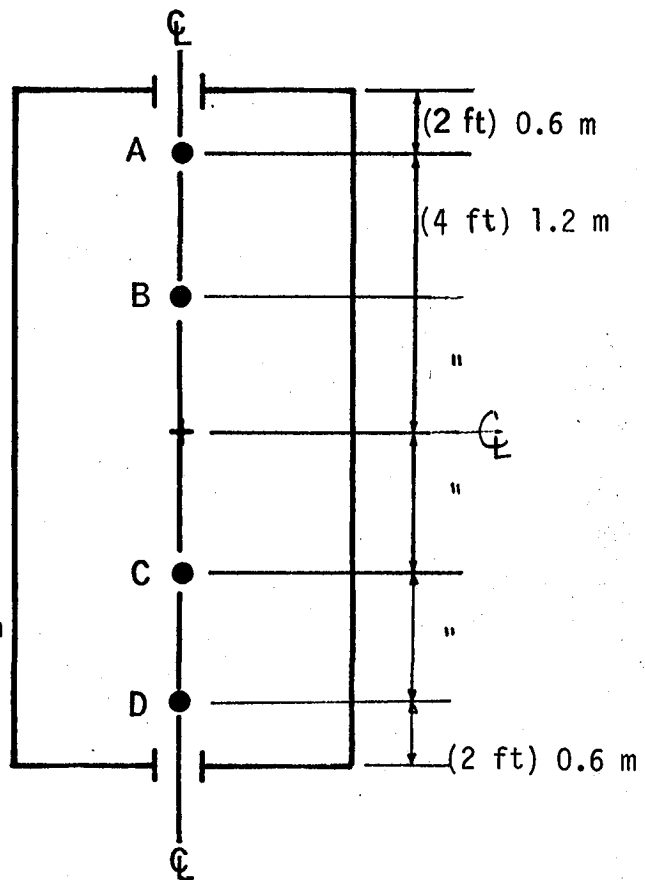
Total of 6 Smoke Meters

Points A and D - smoke meters at 0.75 m (30 in) and 1.5 m (60 in) from floor.

Points B and C - smoke meters at 1.5 m (60 in) from floor.



Cross Section



FWD

Figure 23. - Smoke Meter Locations

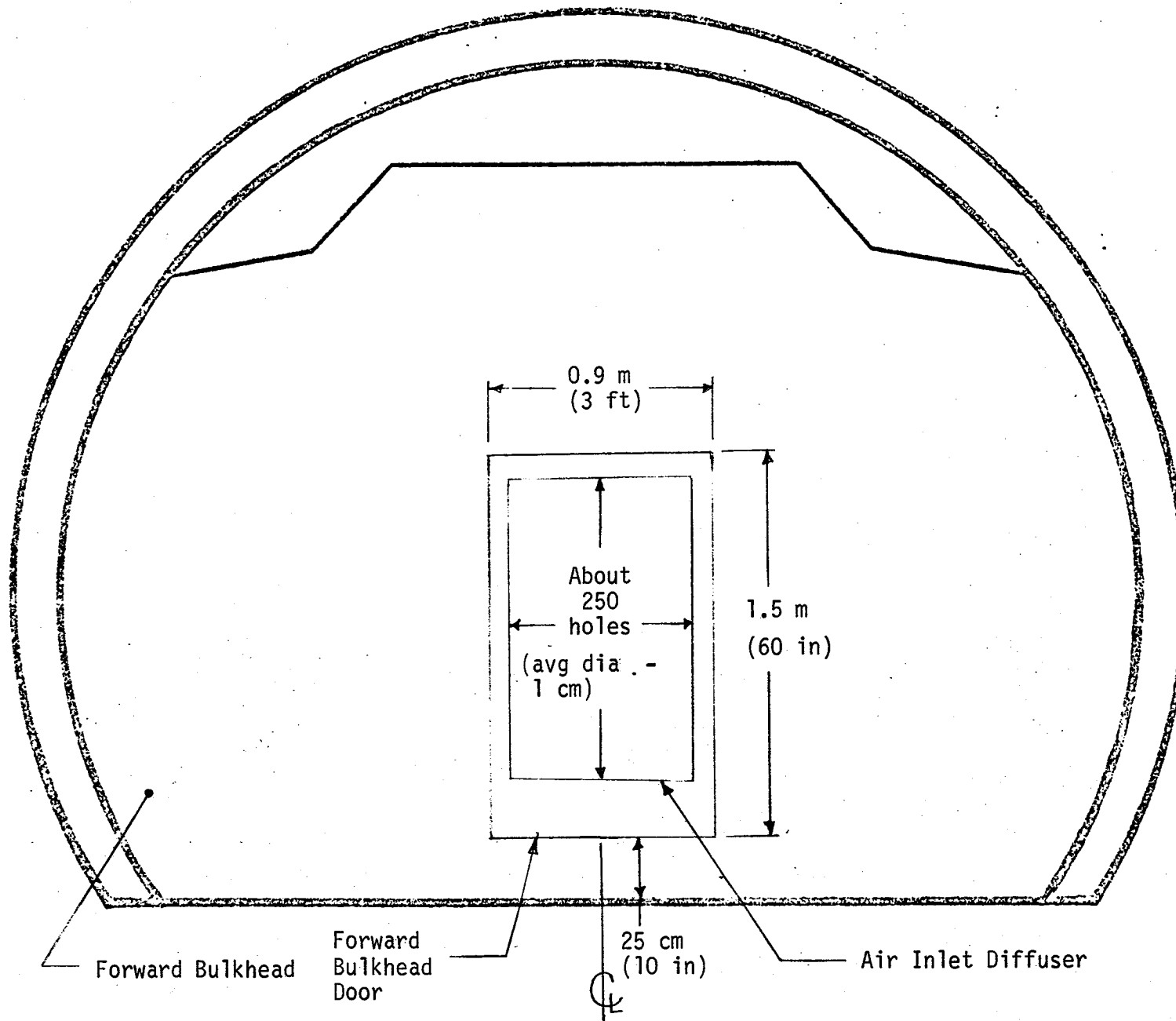


Figure 24. - Air Inlet Diffuser (Forward Bulkhead Door)

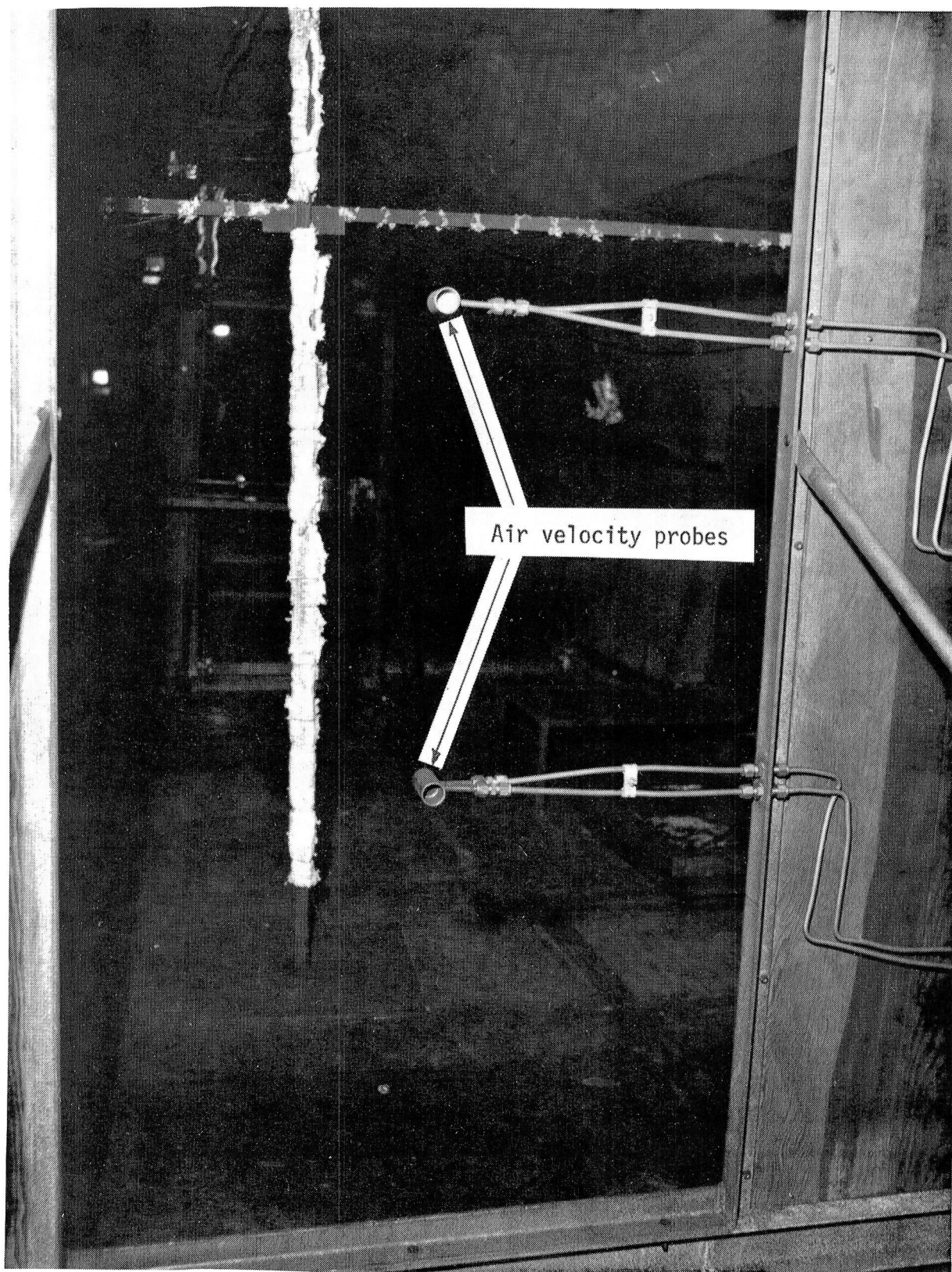


Figure 25. - Aft Air Velocity Probes

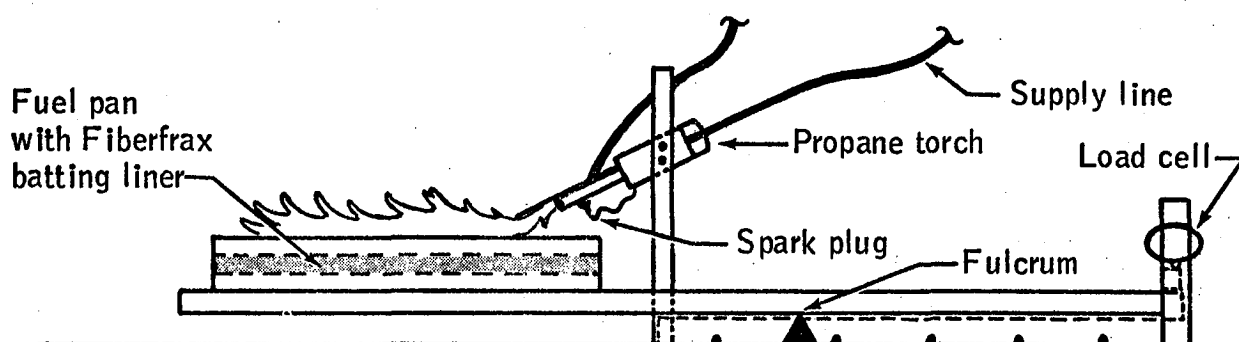


Figure 26. - Components of Fuel Ignition and Fuel Weighing Systems

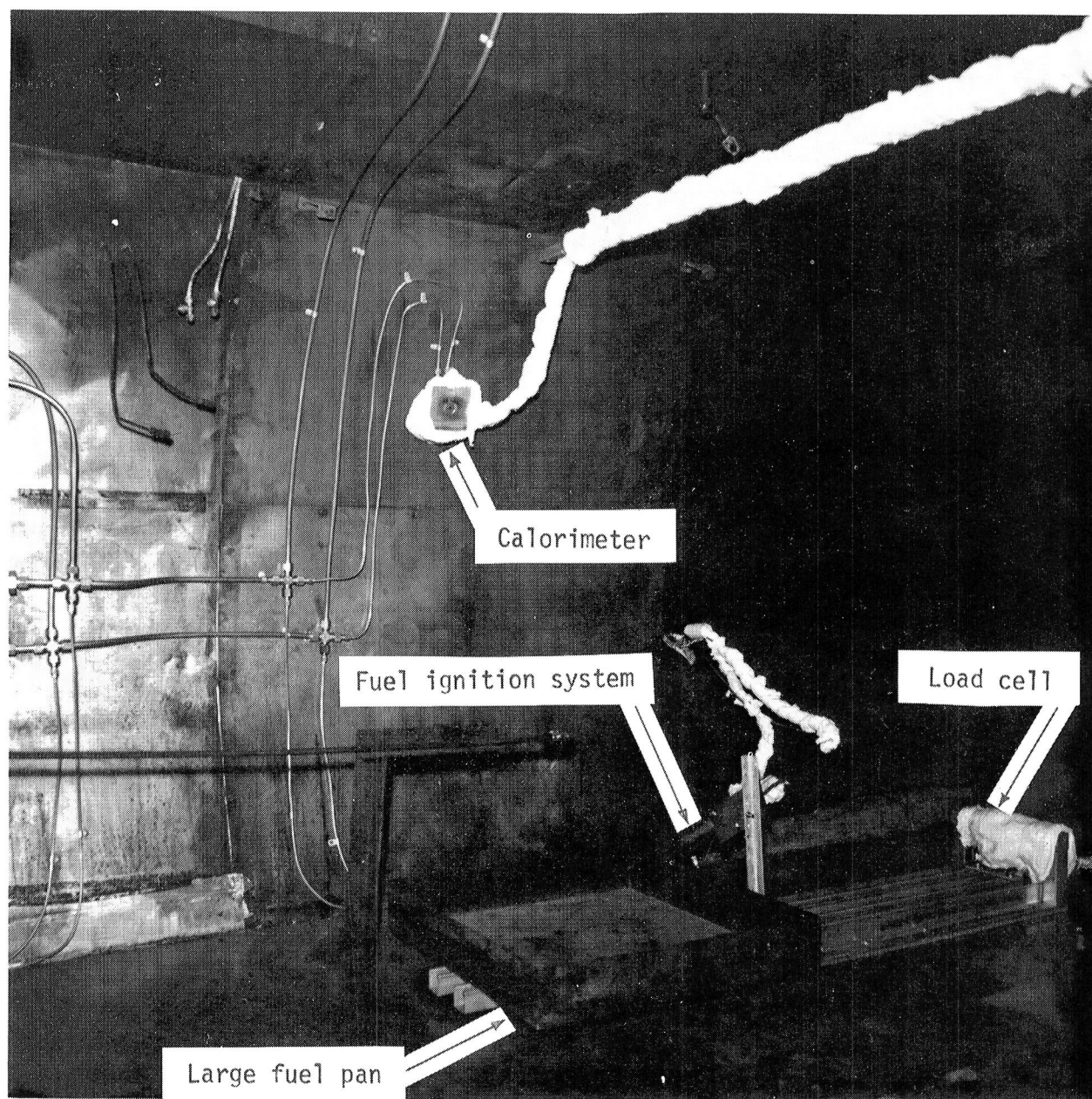


Figure 27 . - View of Fuel Ignition and Fuel Weighing Systems

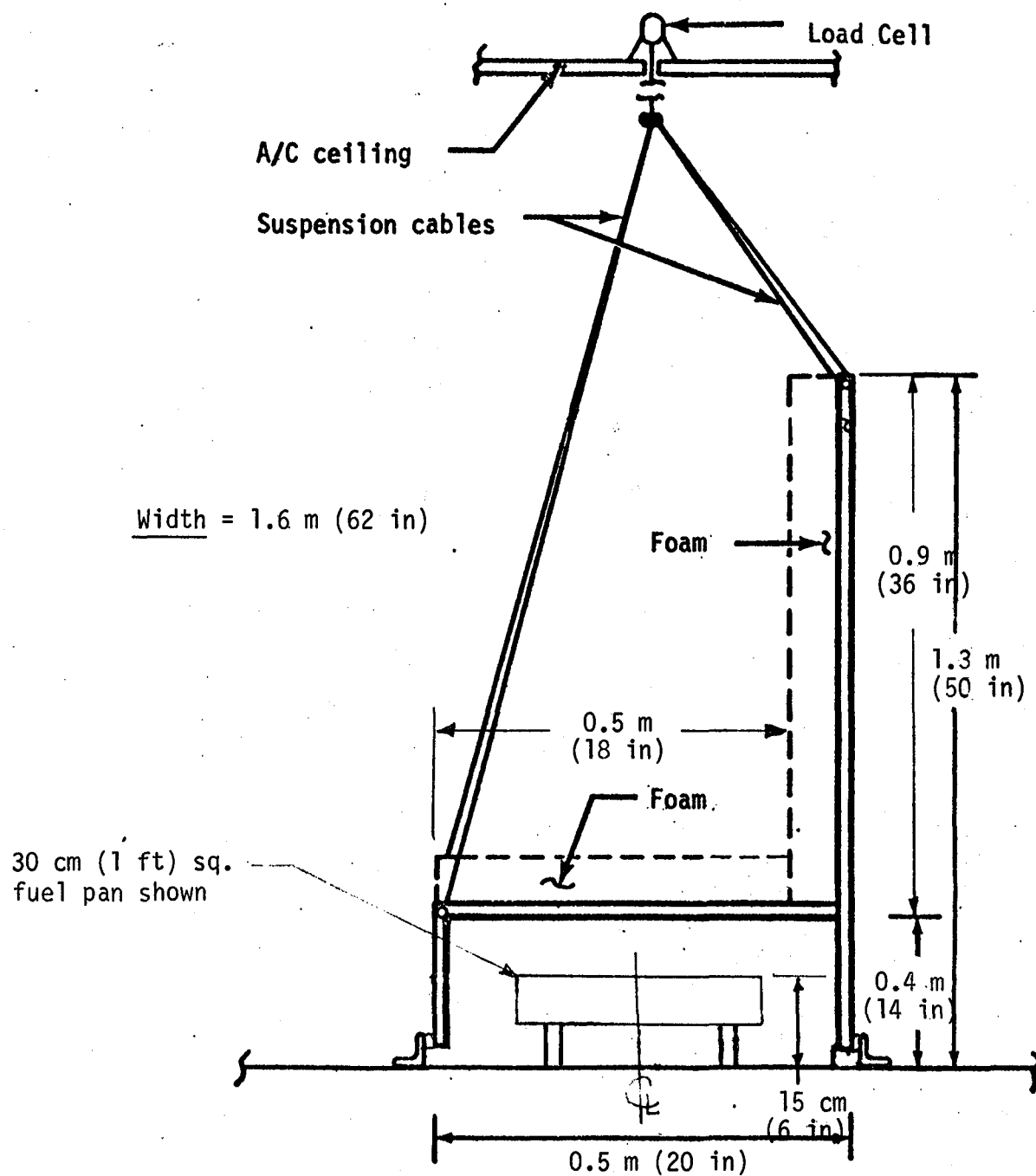


Figure 28. - Dimensions of Seat Assembly Weighing System



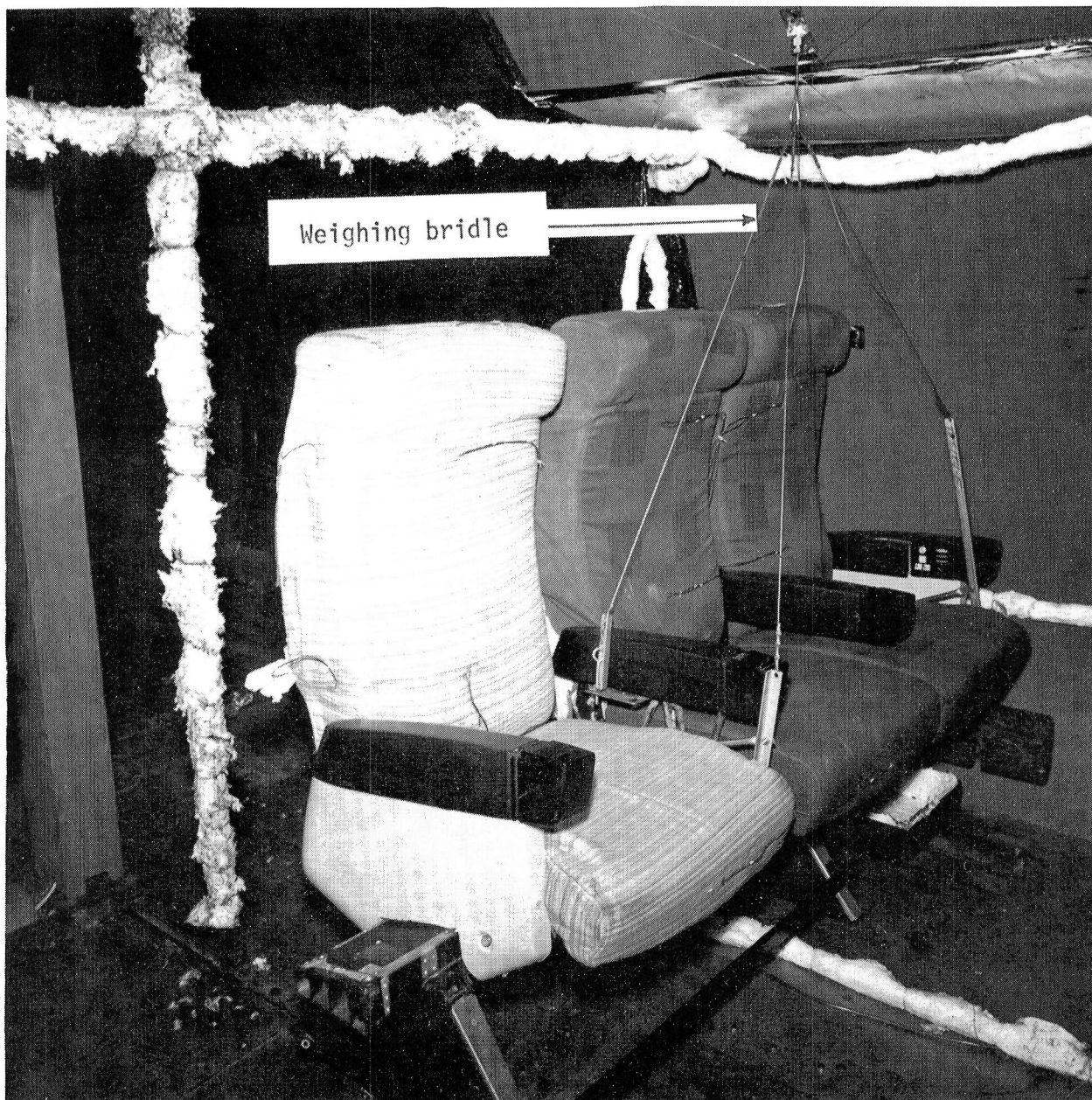


Figure 29 . - View of Seat Assembly Weighing System

## TEST GRAPHS AND PHOTOGRAPHS

TEST 1  

---

FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 1

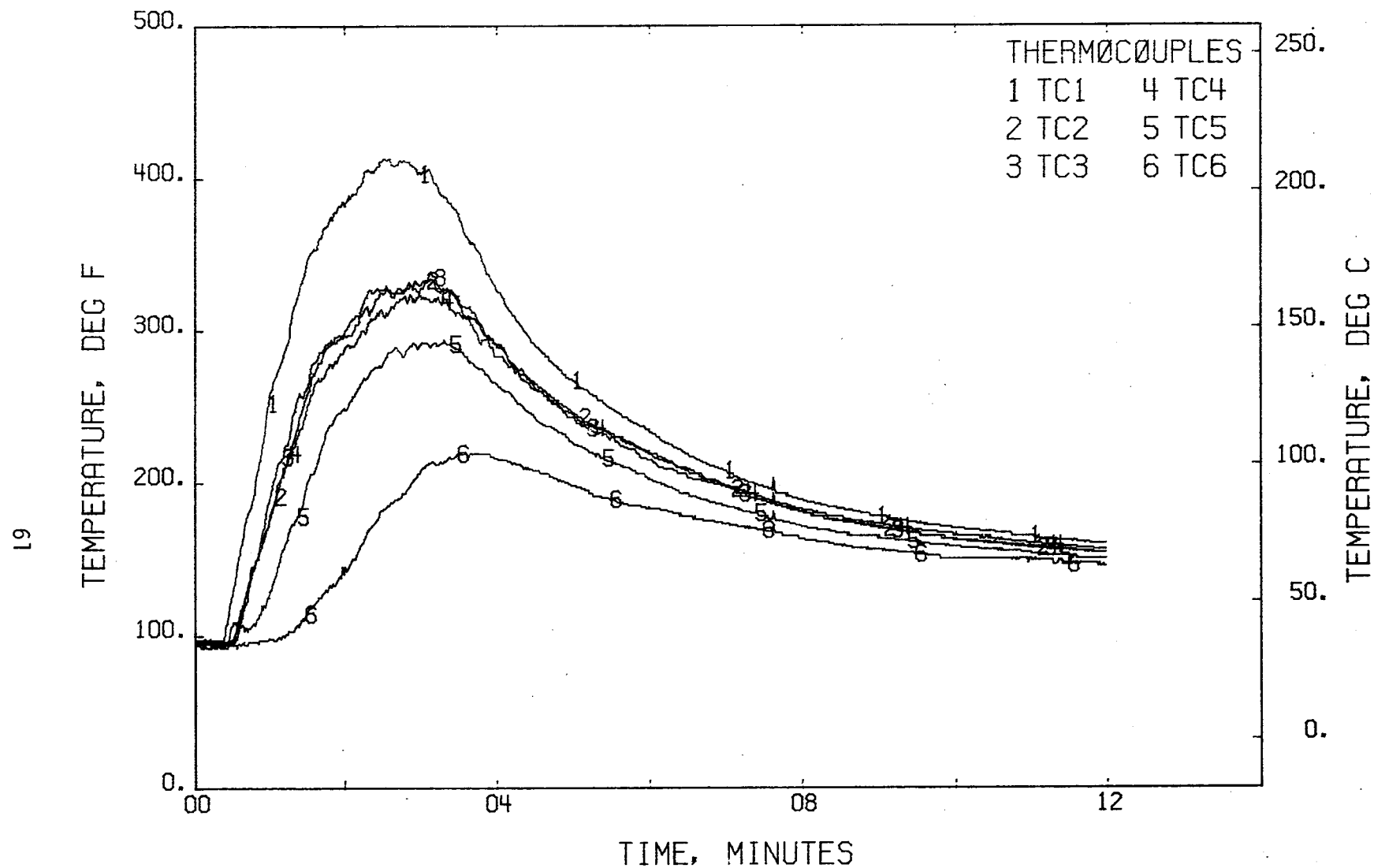


FIGURE 30 . - TEMPERATURES, T/C TREE 1  
TEST 1

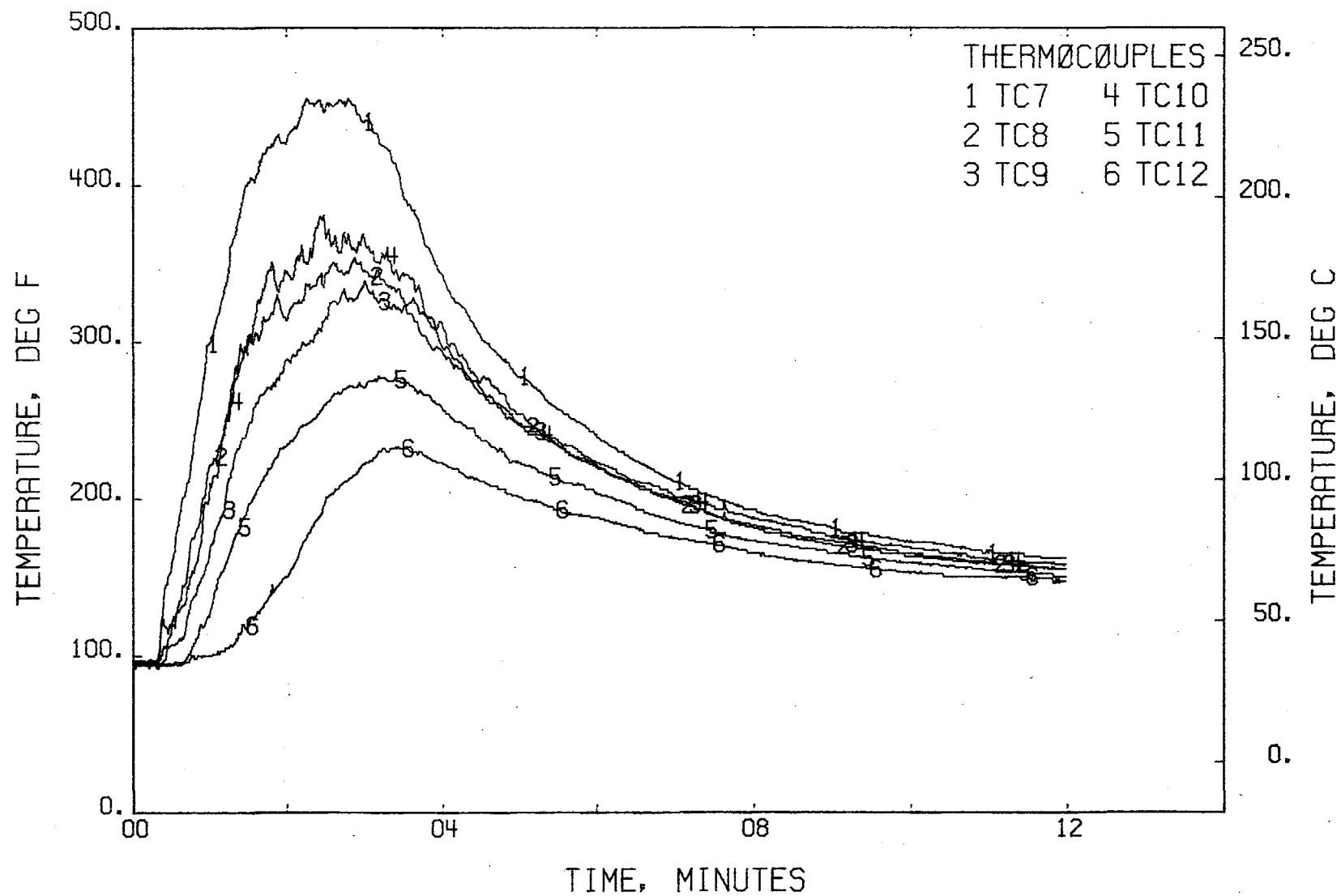


FIGURE 31 . - TEMPERATURES, T/C TREE 2  
TEST 1

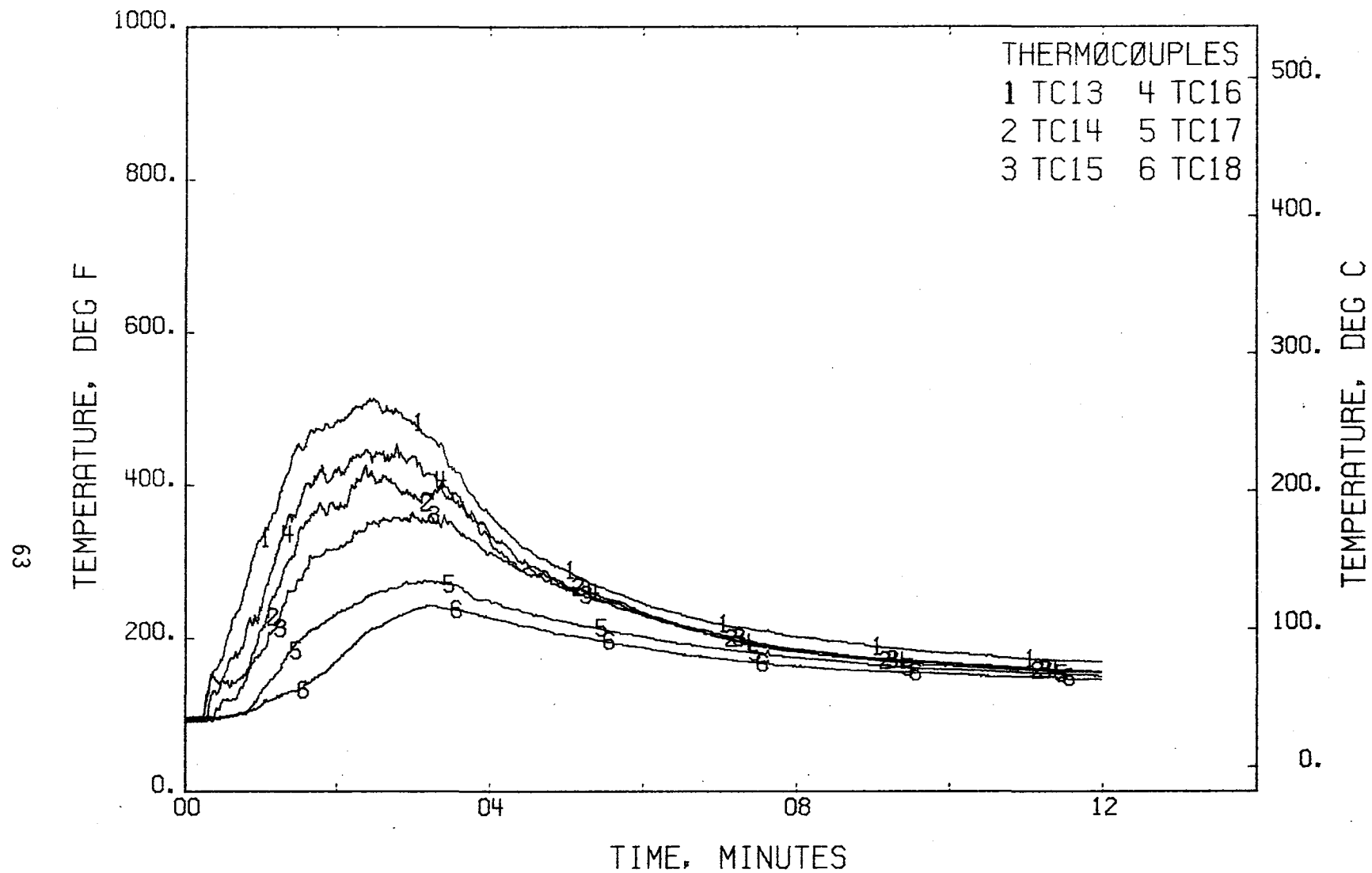


FIGURE 32 . - TEMPERATURES, T/C TREE 3  
TEST 1

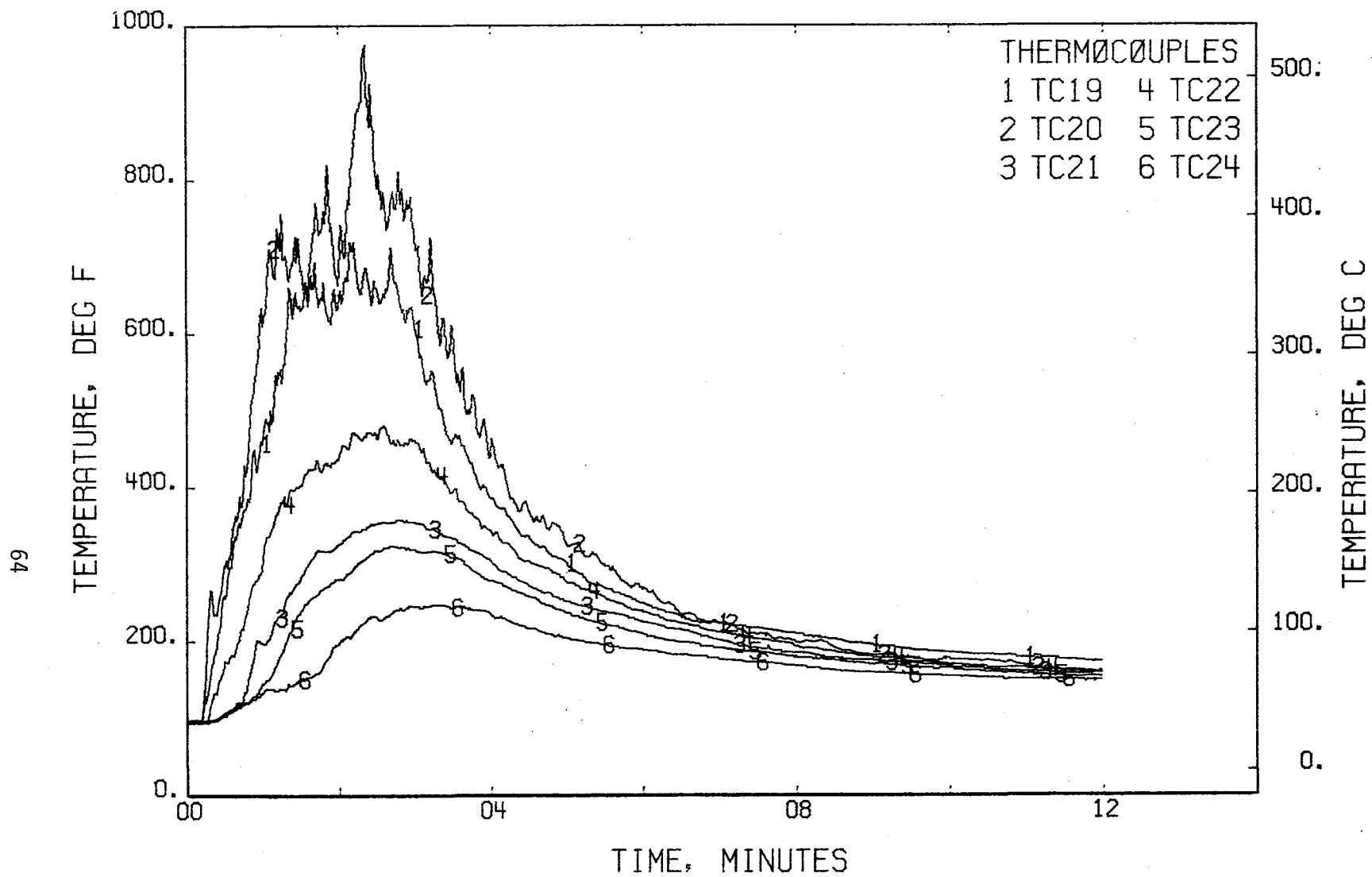


FIGURE 33 . - TEMPERATURES, T/C TREE 4  
TEST 1



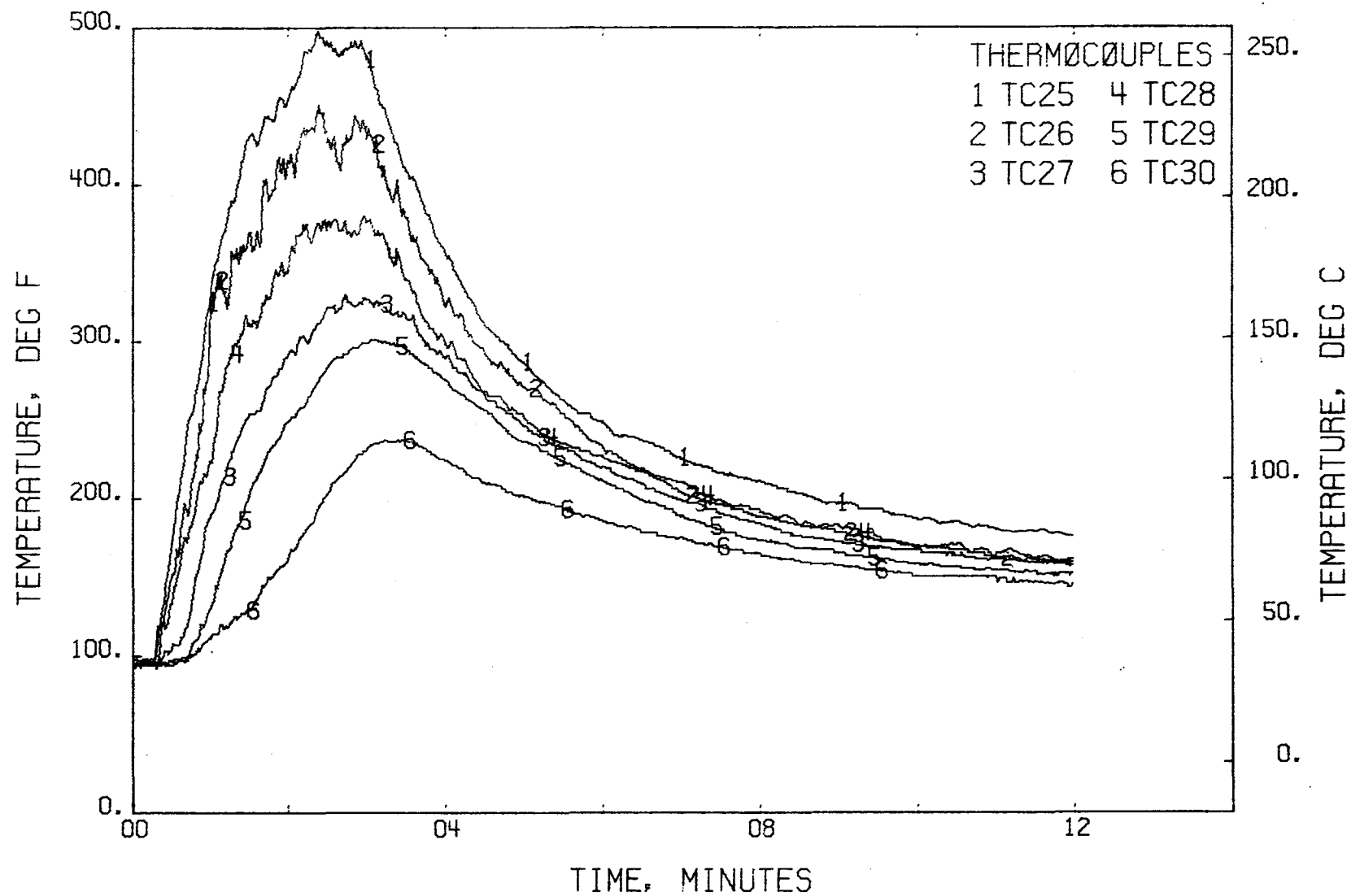


FIGURE 34 . - TEMPERATURES, T/C TREE 5  
TEST 1

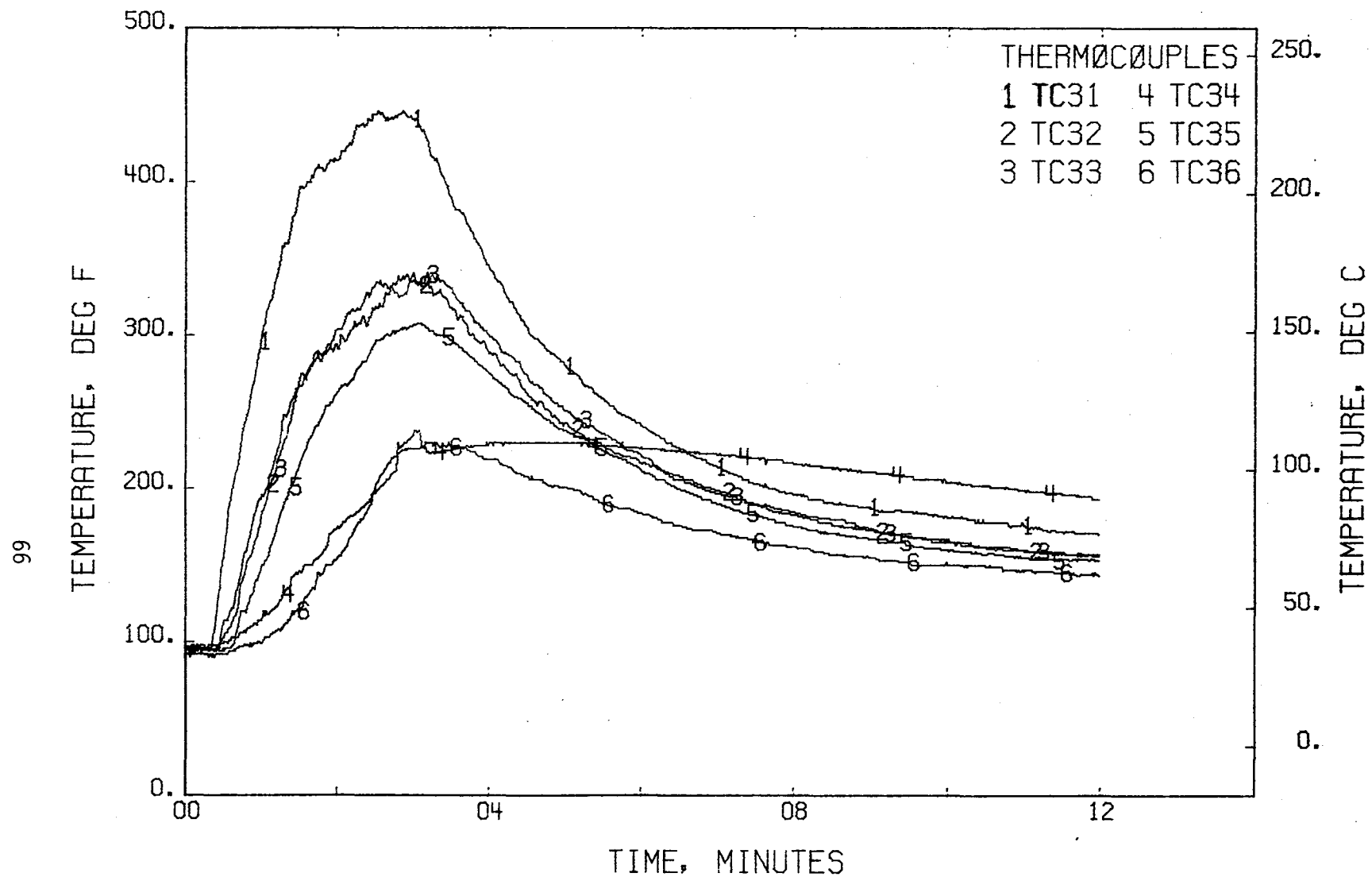


FIGURE 35 . - TEMPERATURES, T/C TREE 6  
TEST 1

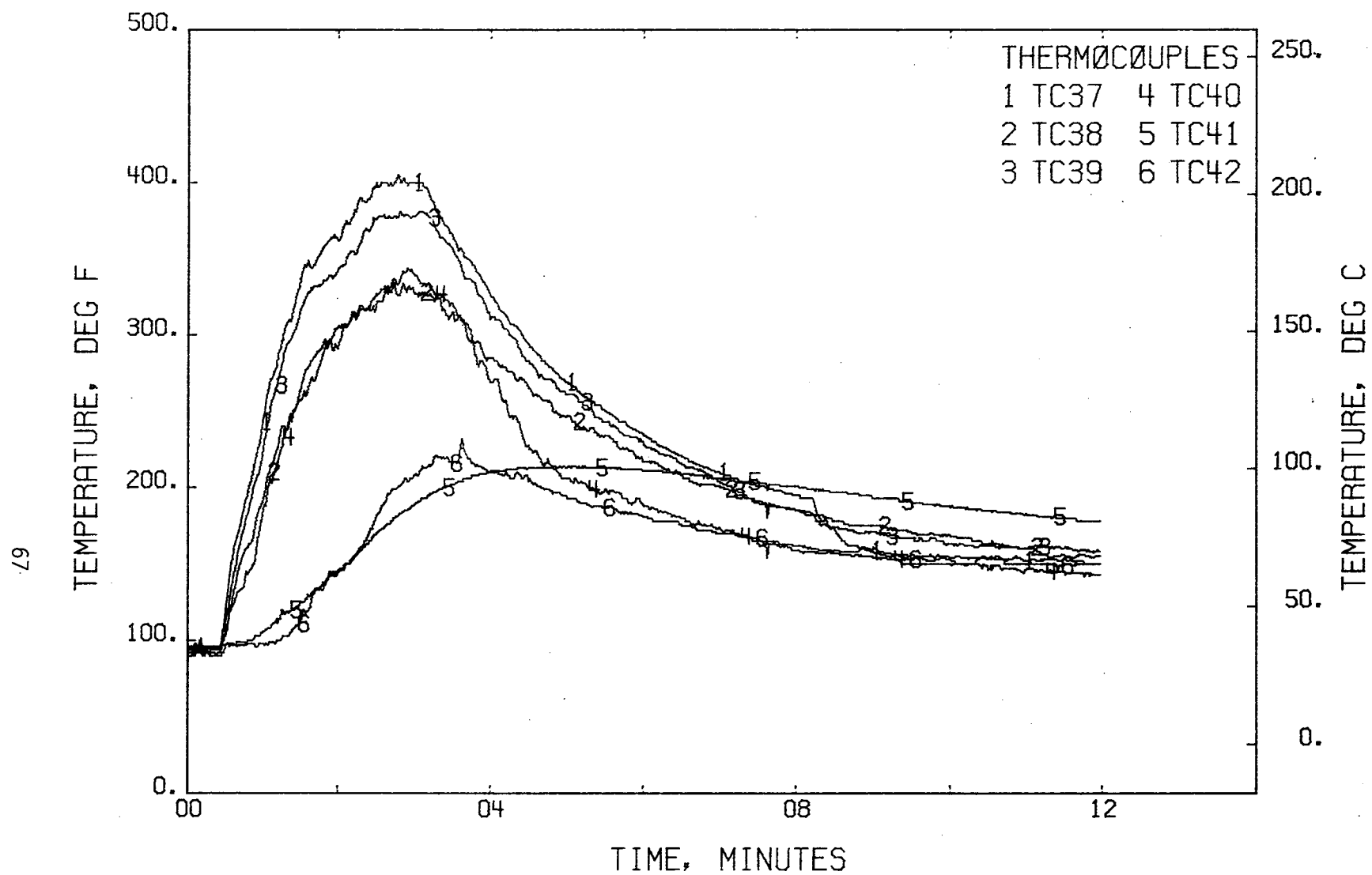


FIGURE 36 . - TEMPERATURES, T/C TREE 7  
TEST 1

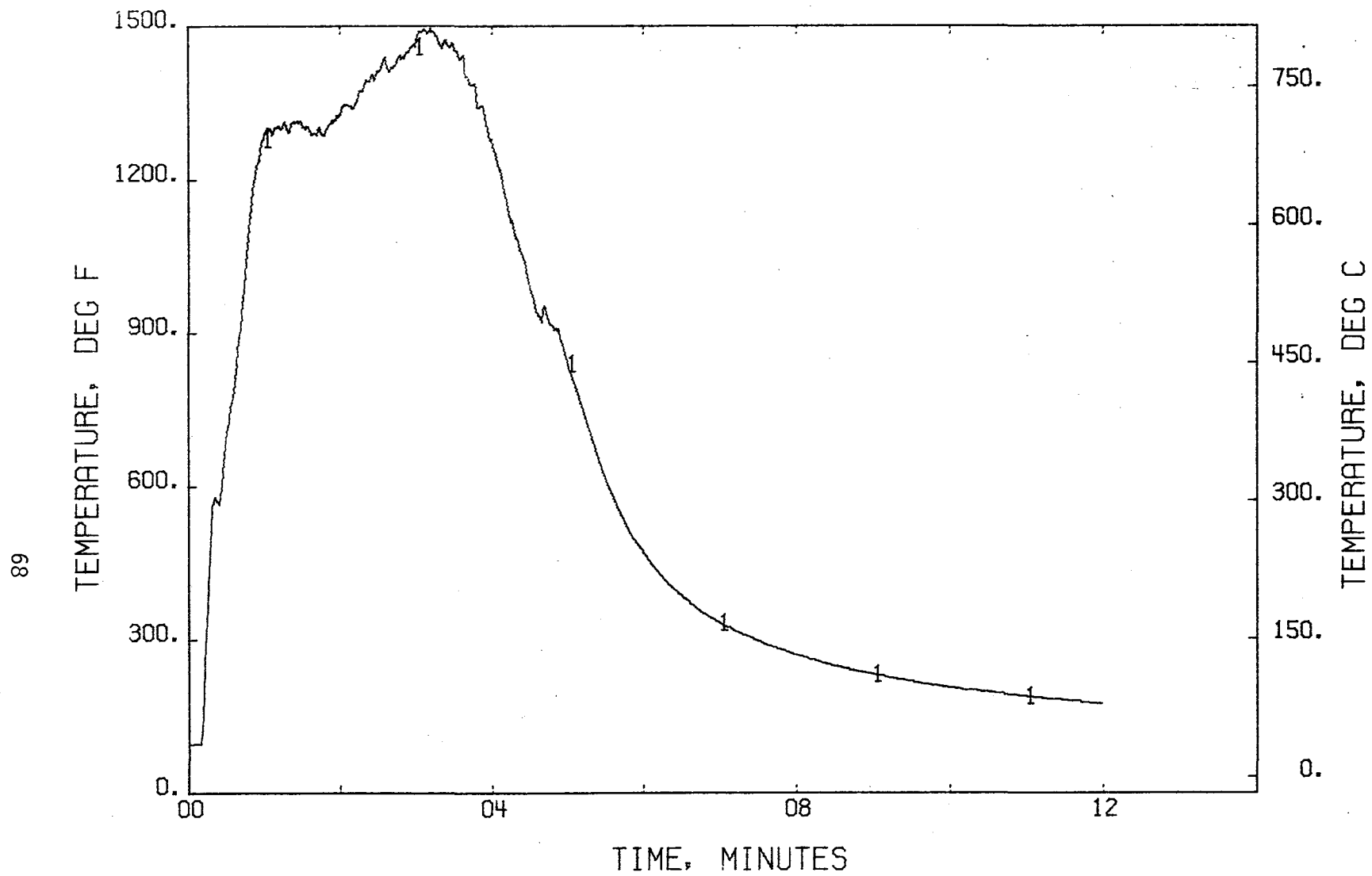


FIGURE 37 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 1

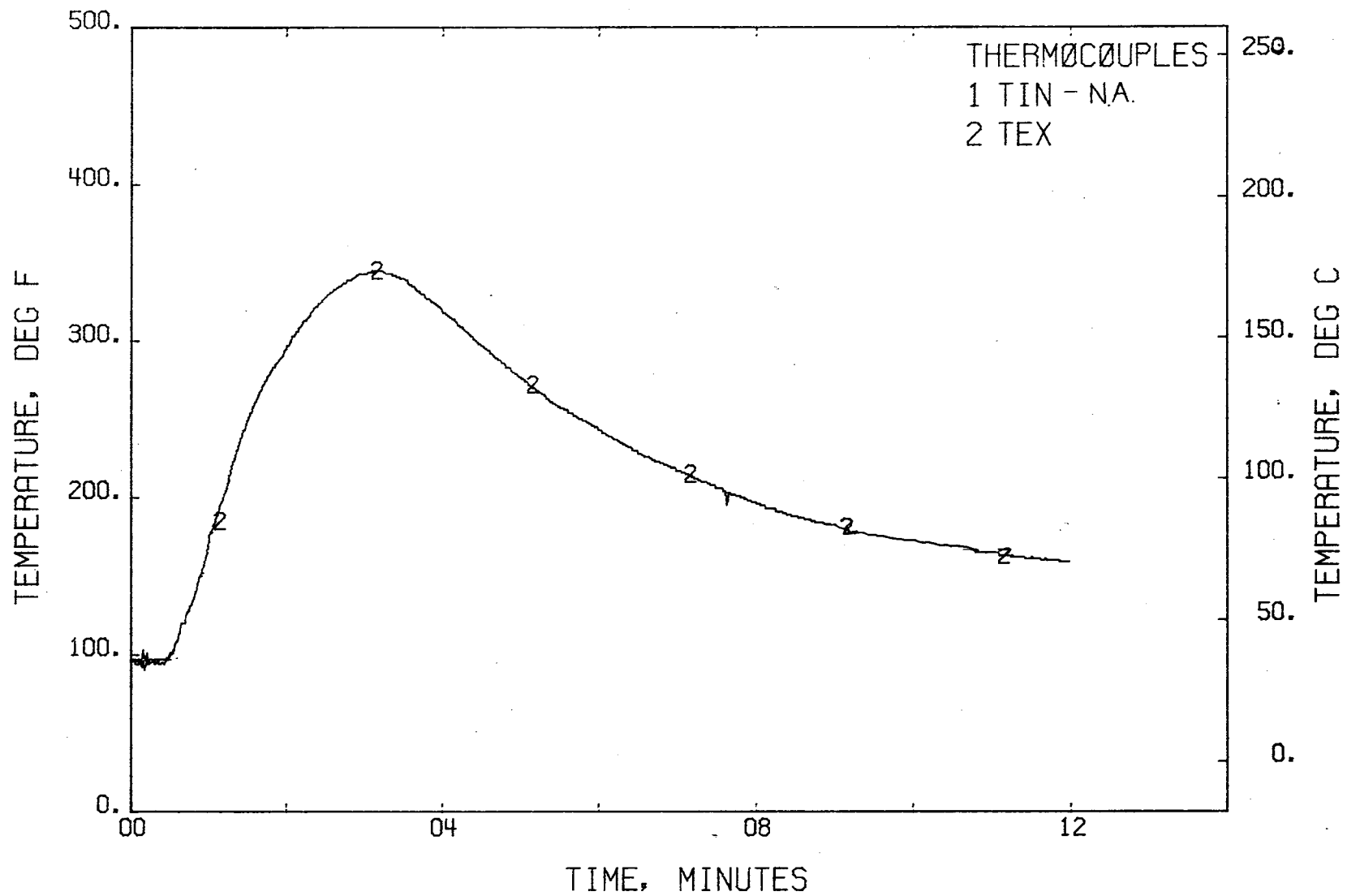


FIGURE 38 . - TEMPERATURES, INLET + EXIT  
TEST 1

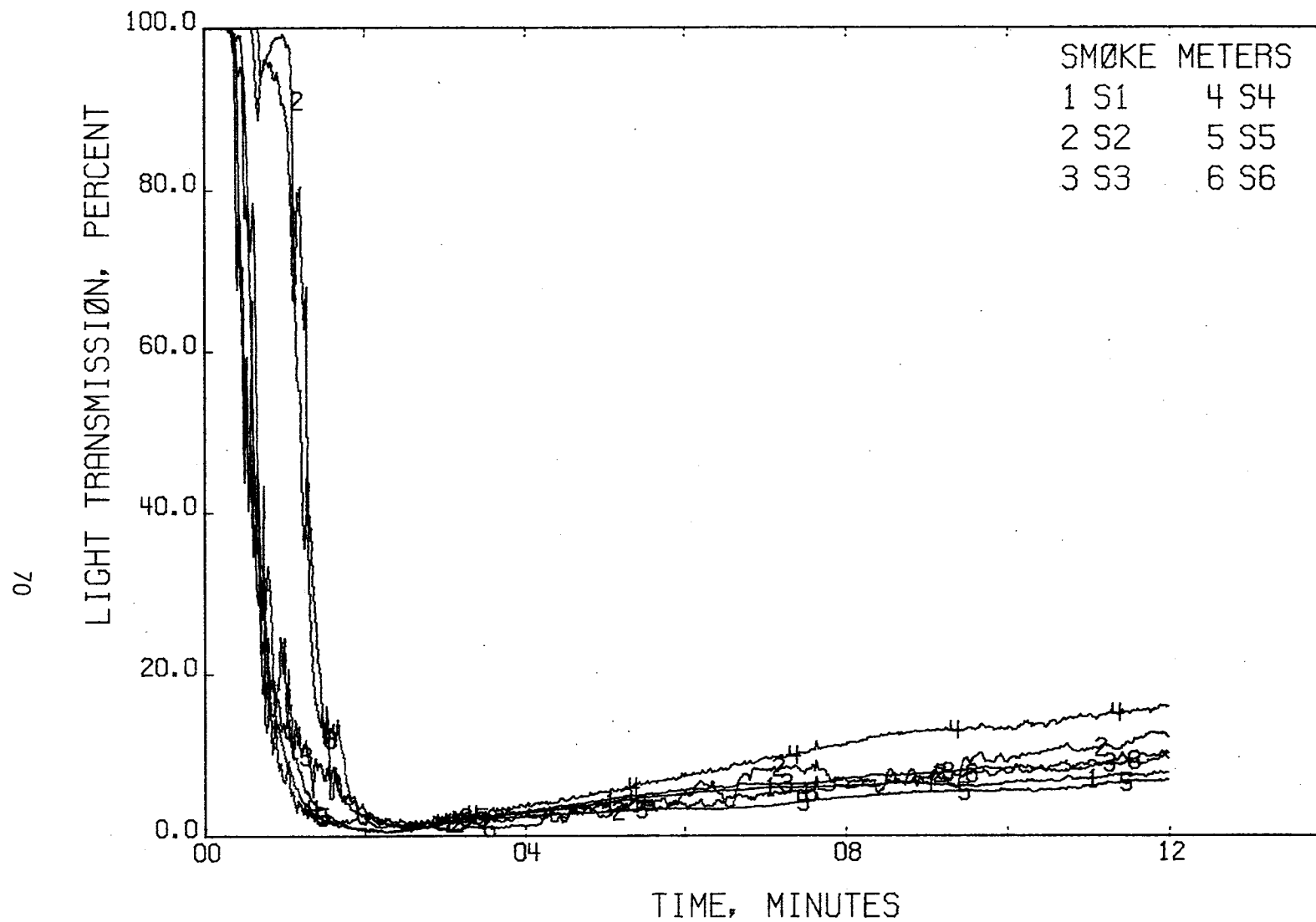


FIGURE 39 . - LIGHT TRANSMISSION  
TEST 1

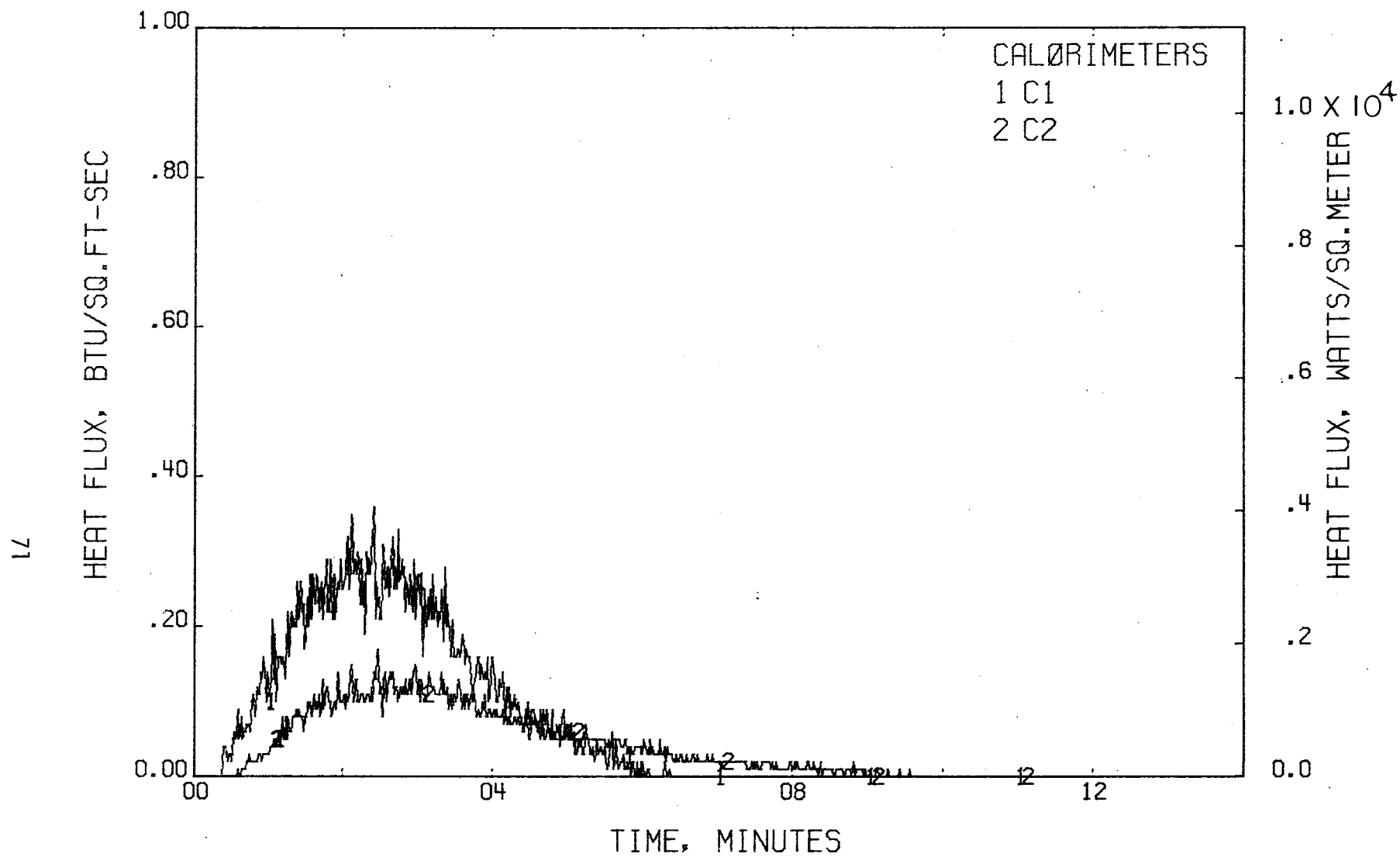


FIGURE 40 . - HEAT FLUX, AFT  
TEST 1

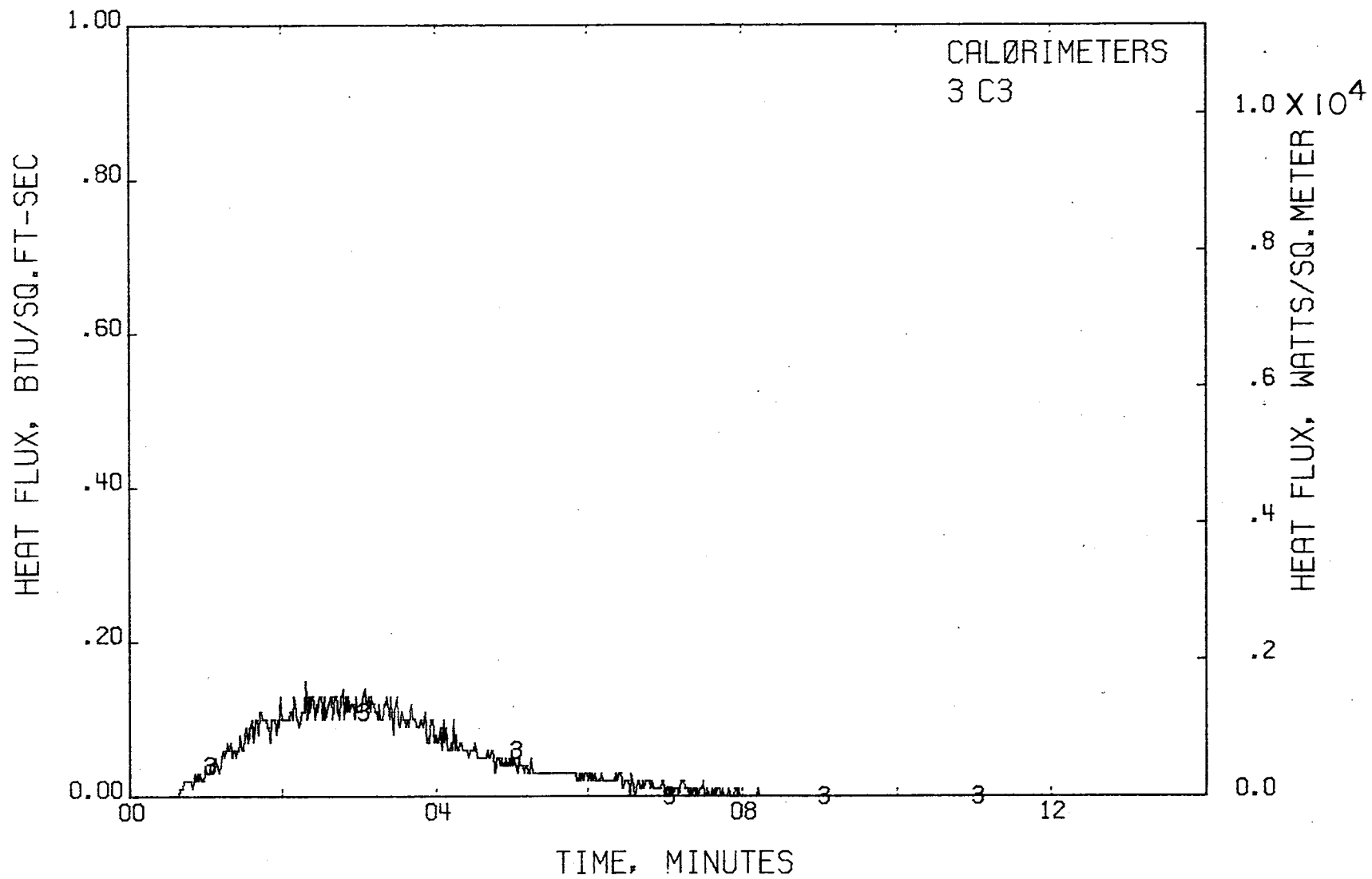


FIGURE 40 . - HEAT FLUX, AFT - CONTINUED  
TEST 1



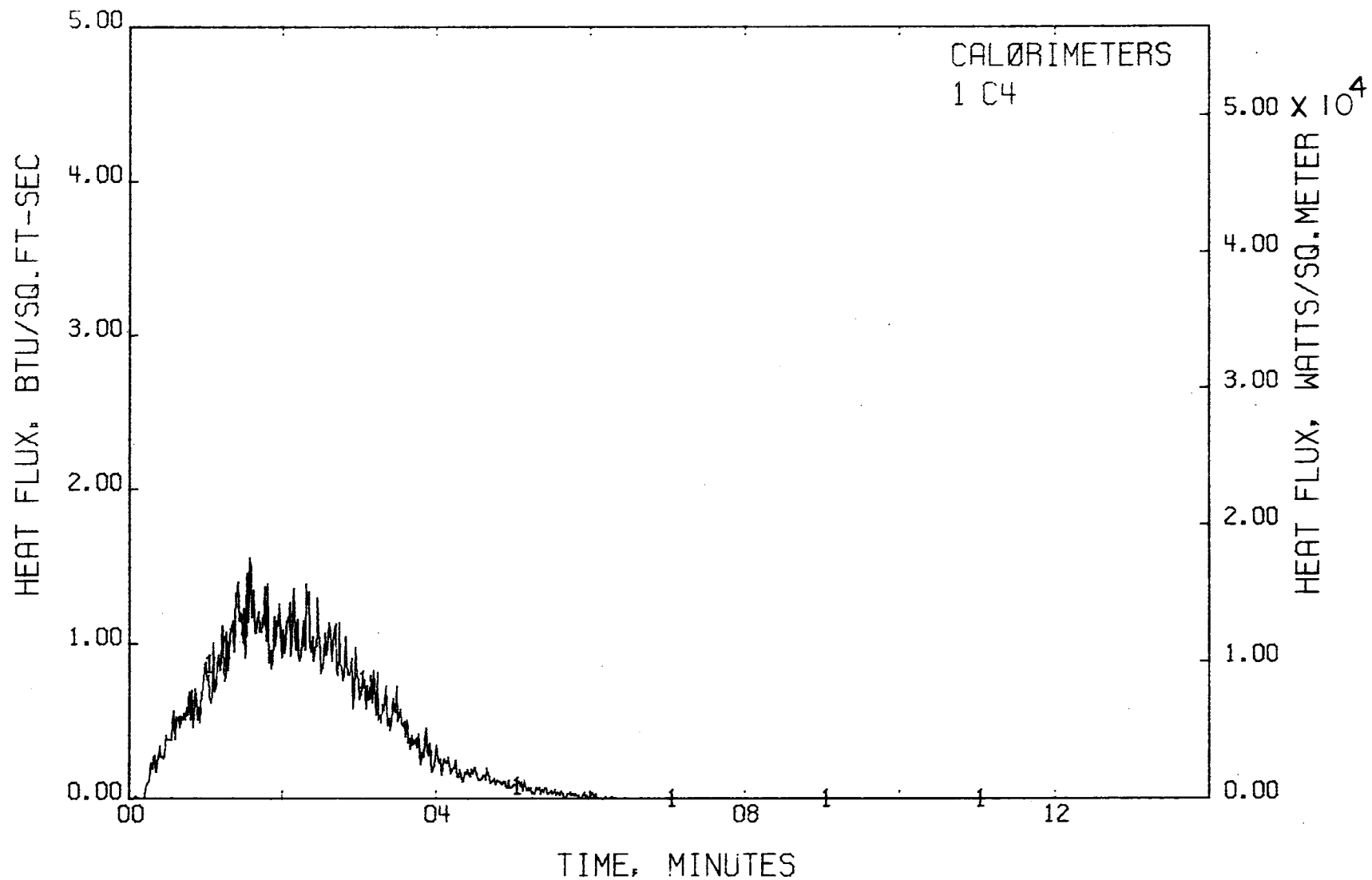


FIGURE 41 . - HEAT FLUX, MIDSECTION  
TEST 1

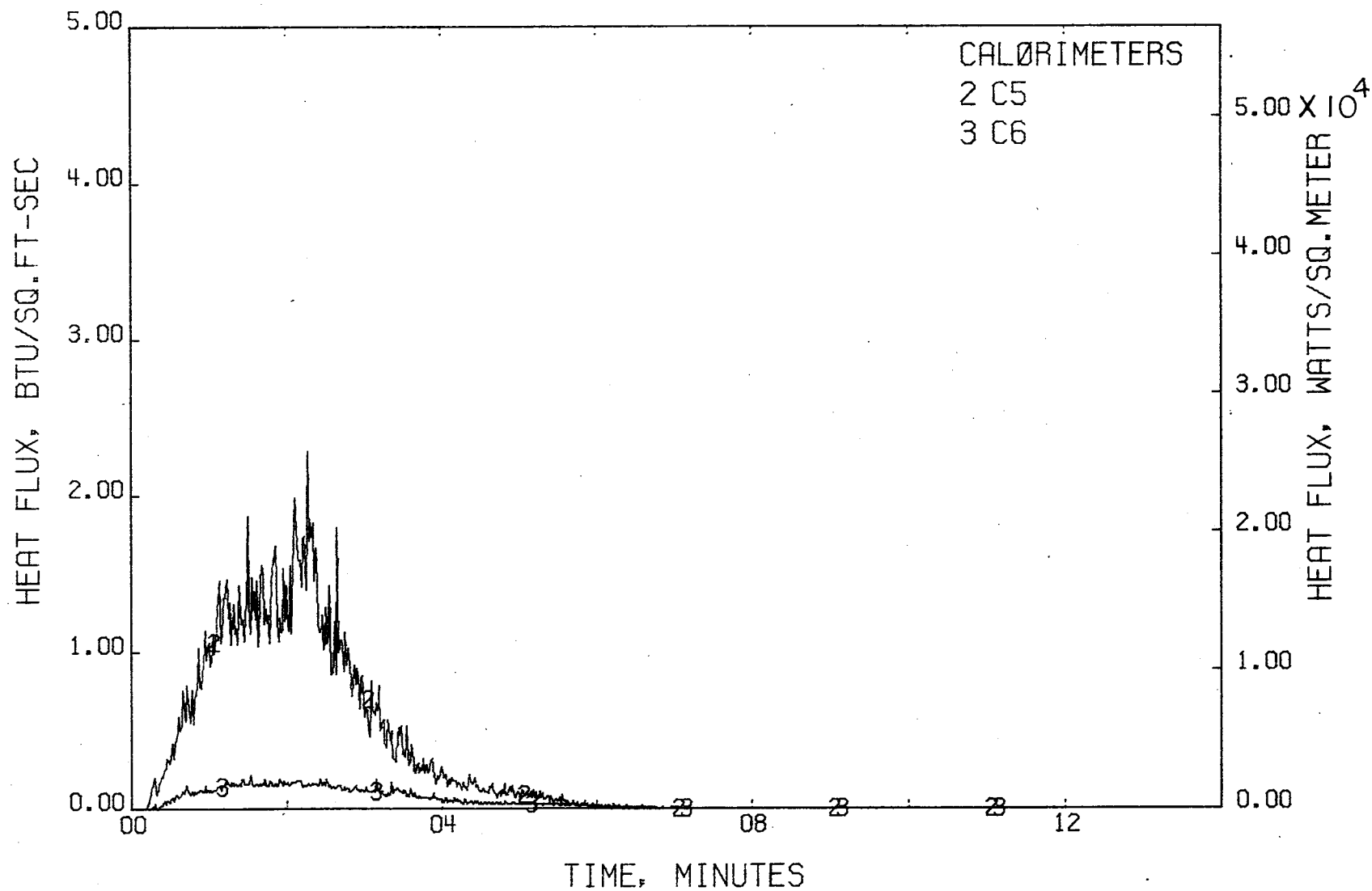
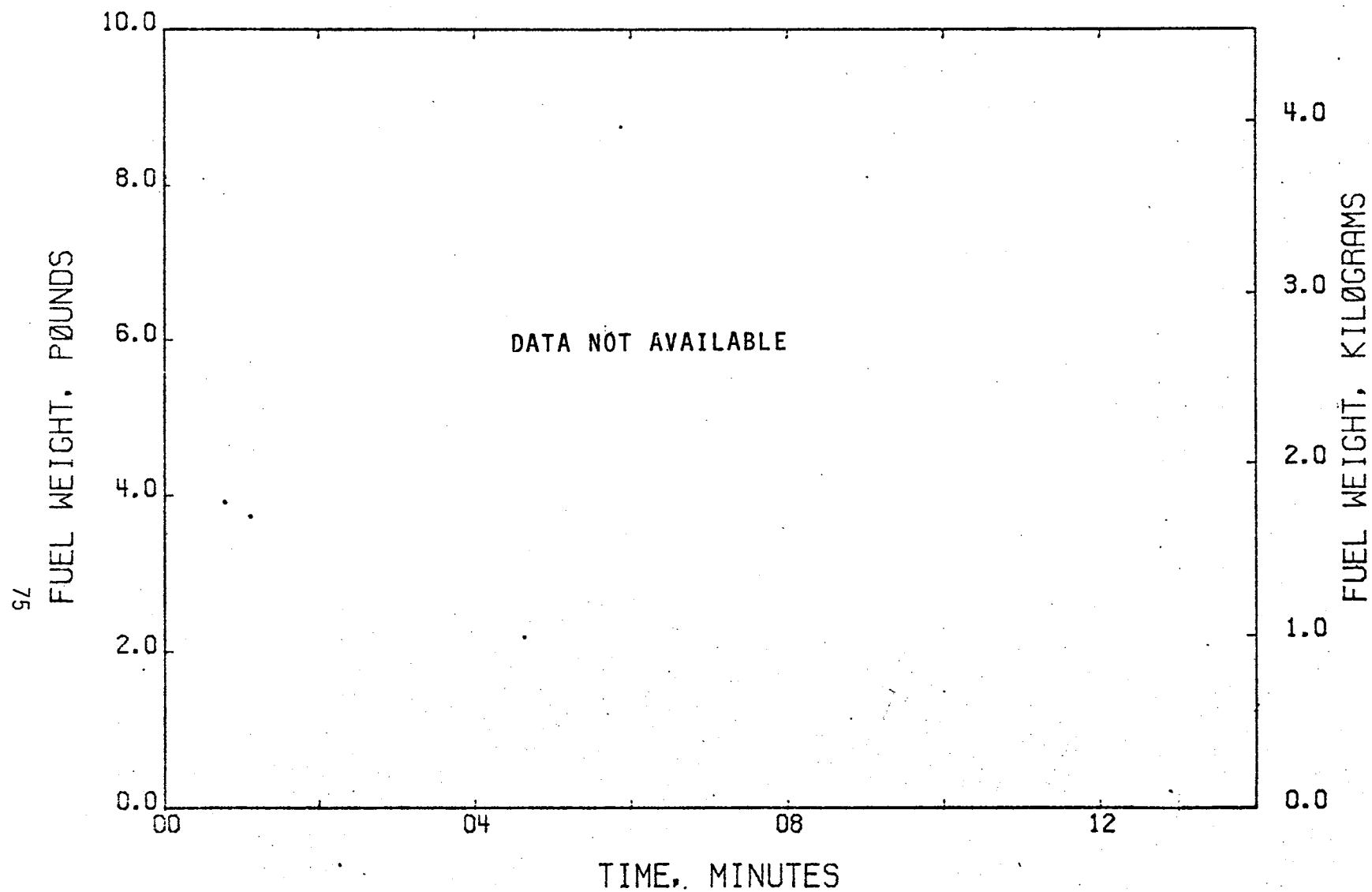


FIGURE 41 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 1



FUEL WEIGHT LOSS  
TEST 1

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM

HYDROGEN FLUORIDE - <12 PPM

HYDROGEN CHLORIDE - <24 PPM

FIGURE 42 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 1

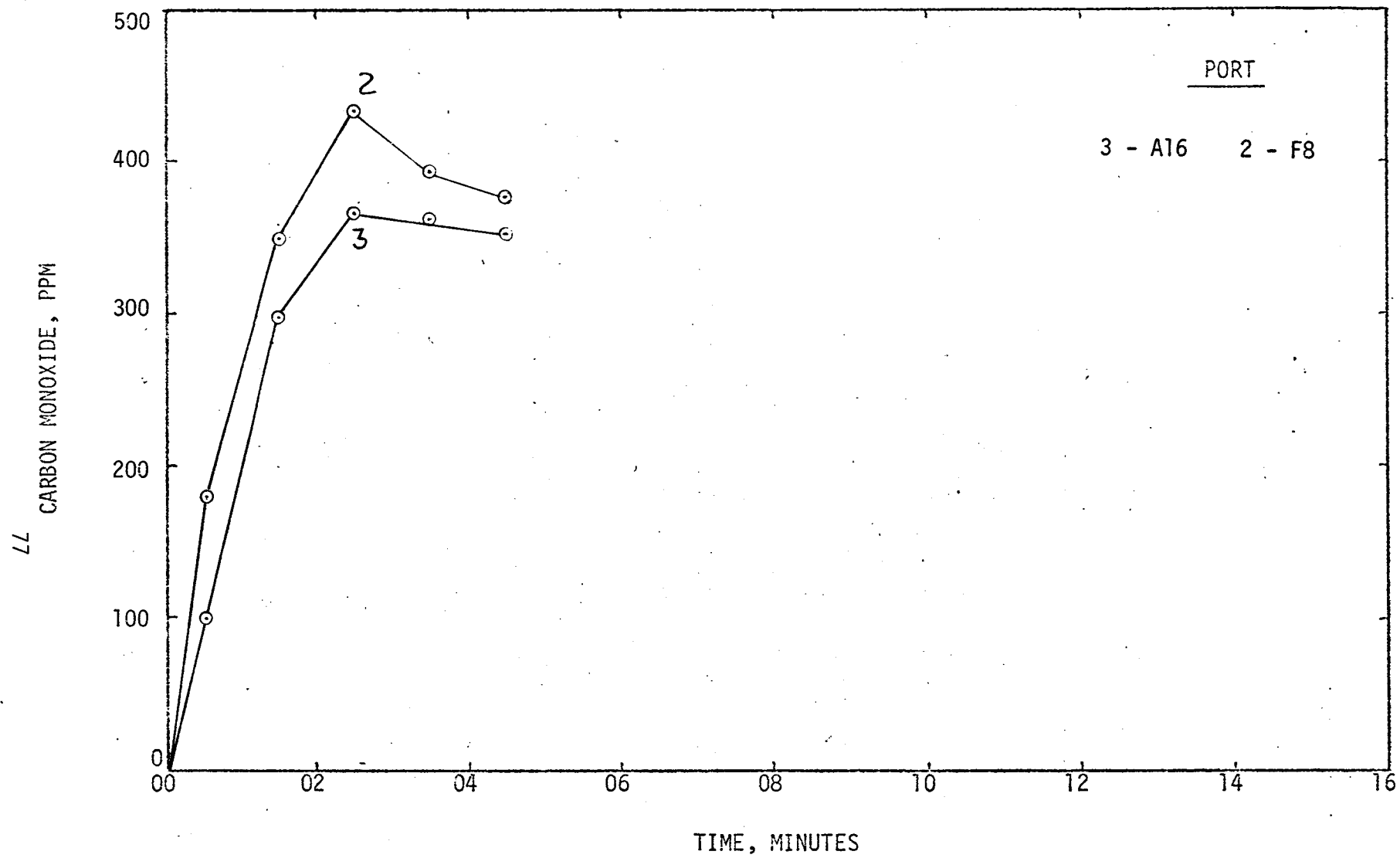


FIGURE 43 . - CARBON MONOXIDE CONCENTRATIONS  
TEST 1

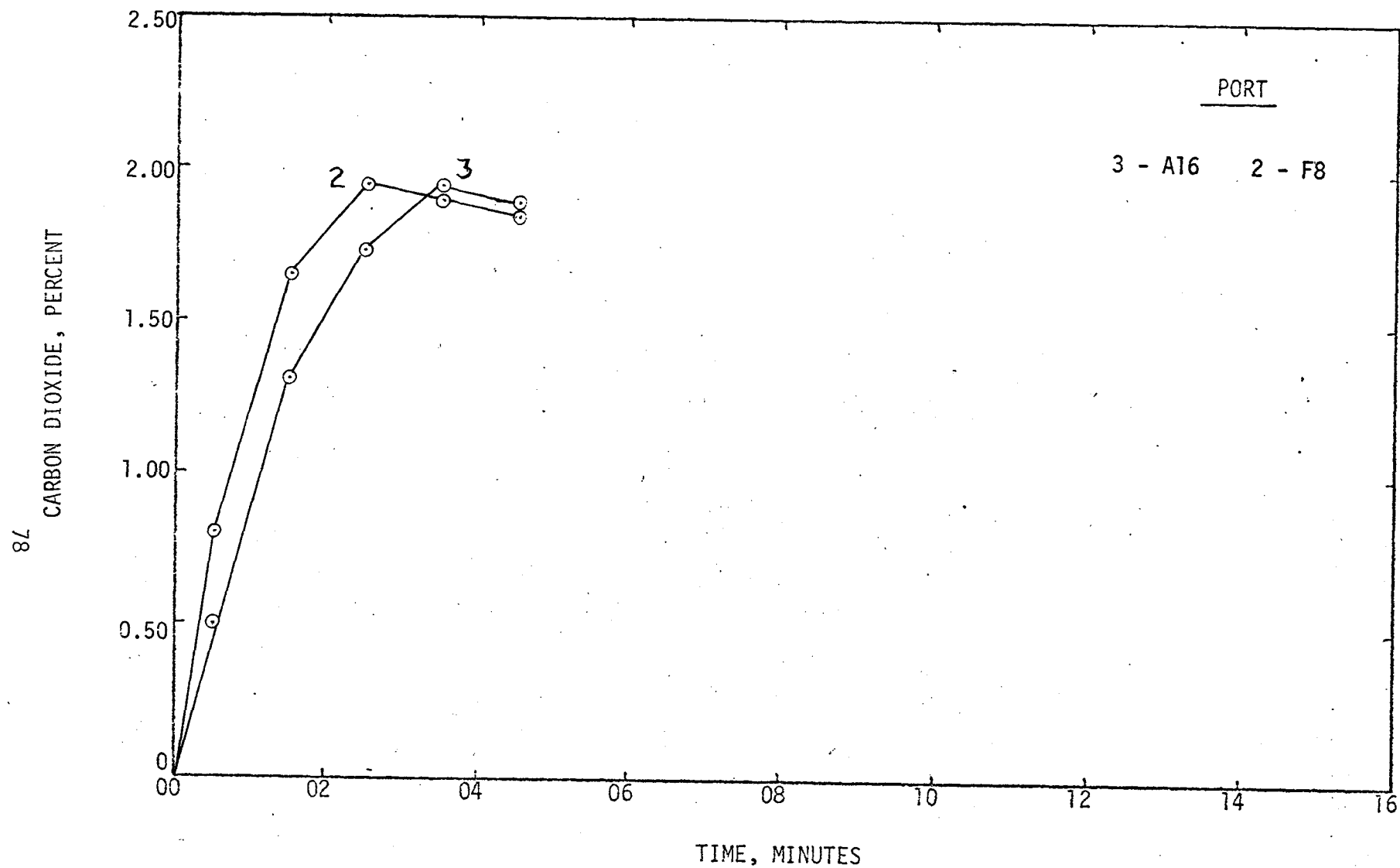


FIGURE 44 . - CARBON DIOXIDE CONCENTRATIONS  
TEST 1

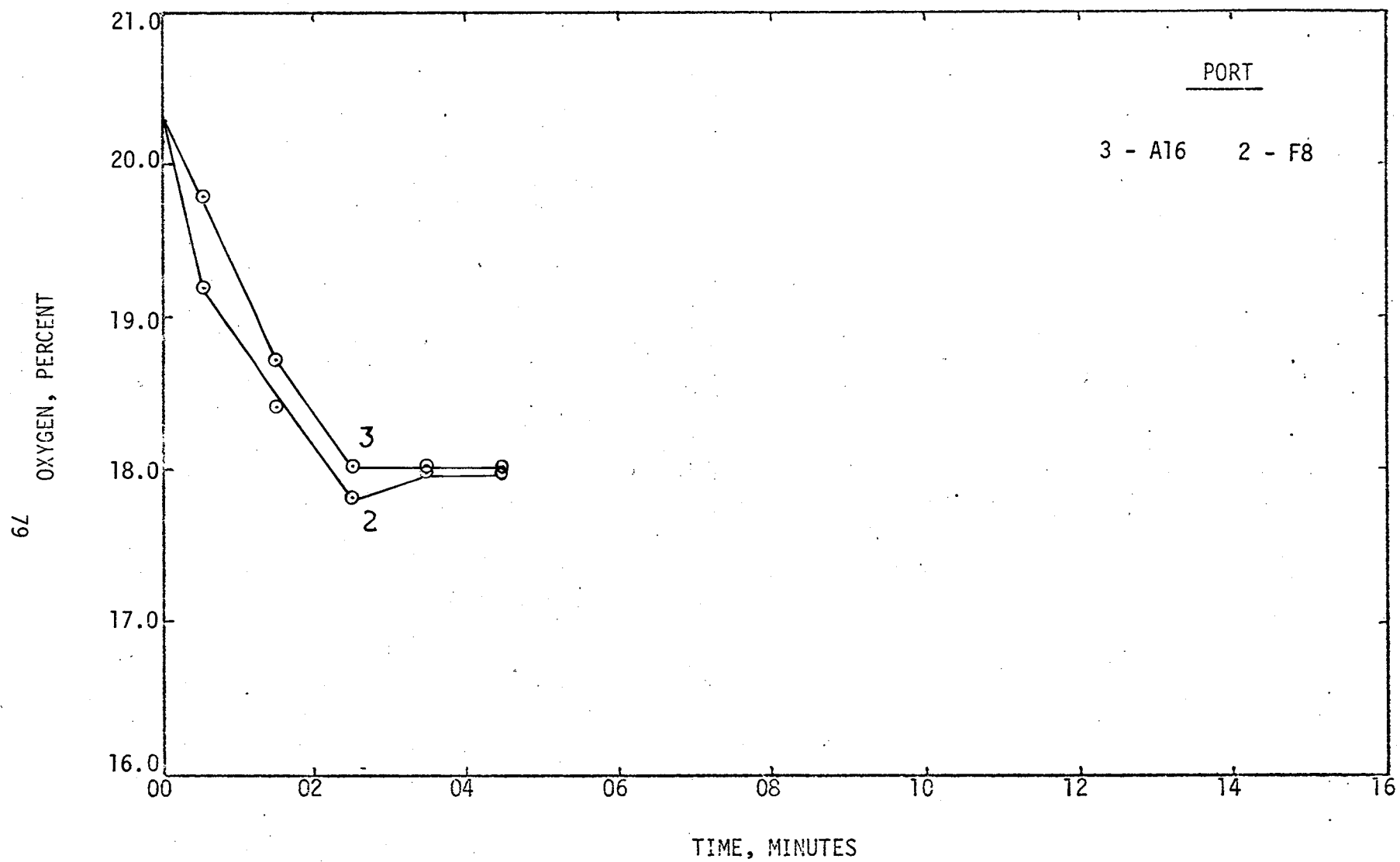


FIGURE 45 - OXYGEN CONCENTRATIONS

TEST 1

TEST 2  

---

FUEL ONLY



NO PHOTOS WERE TAKEN FOR TEST 2

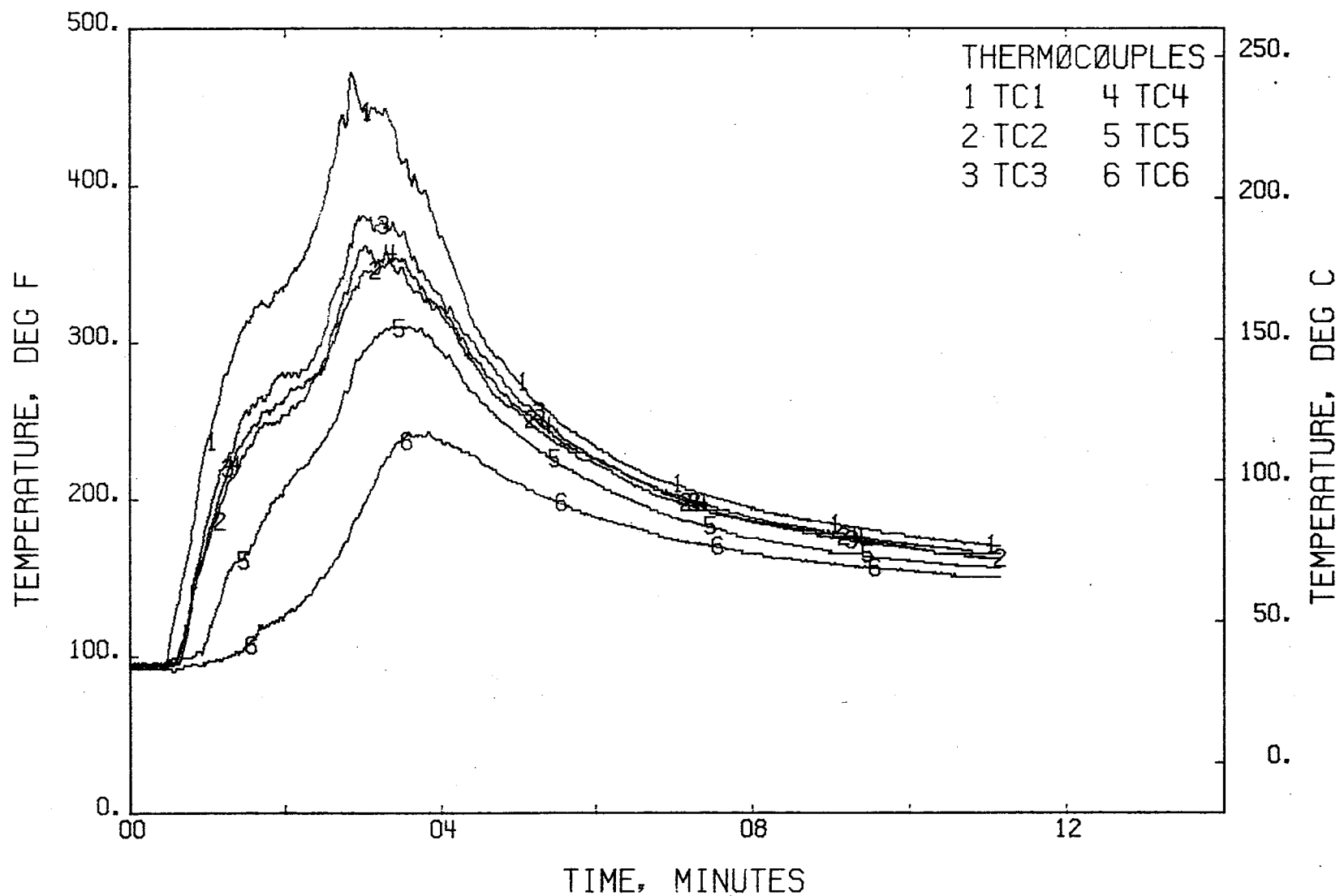


FIGURE 46 . - TEMPERATURES, T/C TREE 1  
TEST 2

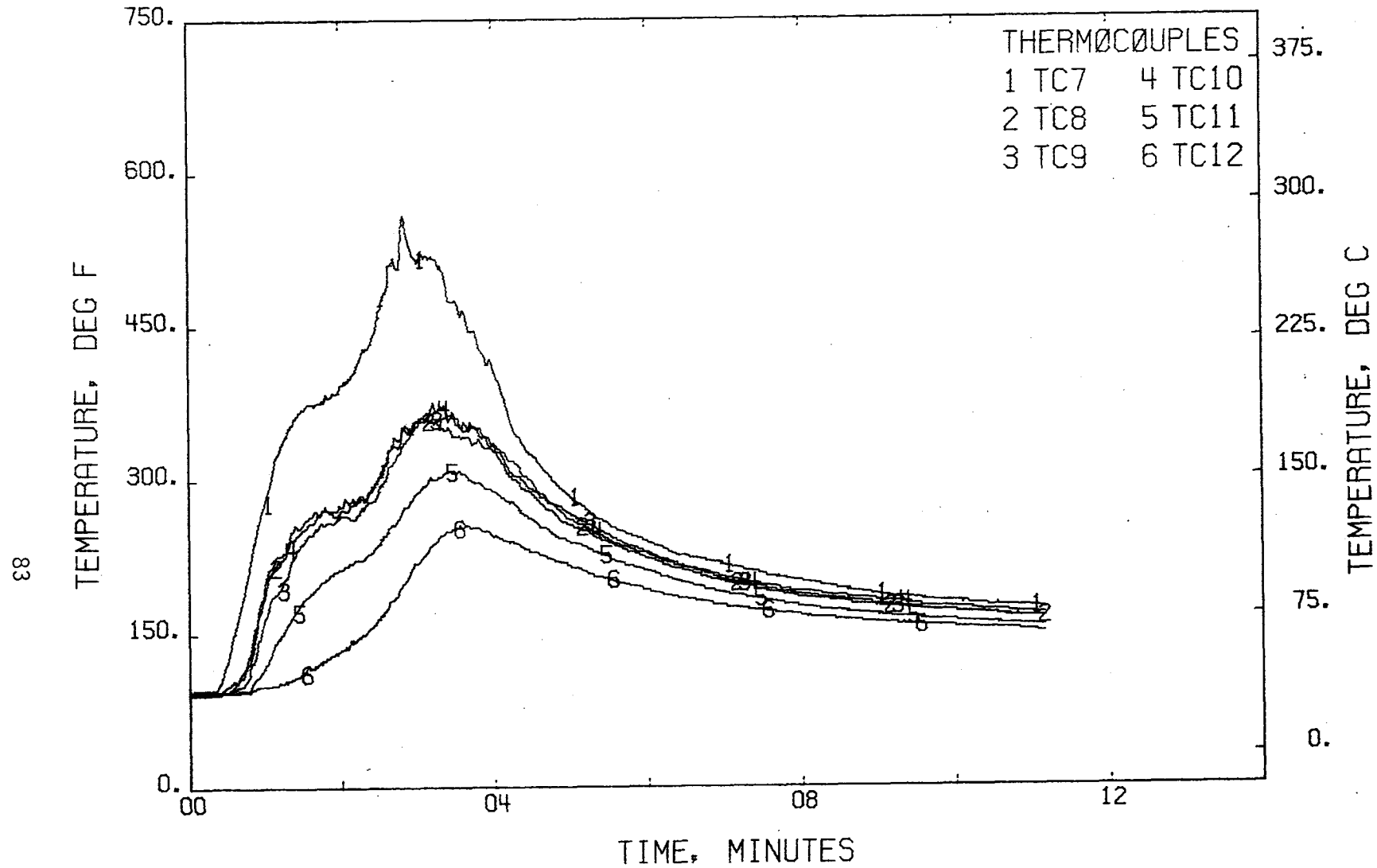


FIGURE 47 . - TEMPERATURES, T/C TREE 2  
TEST 2

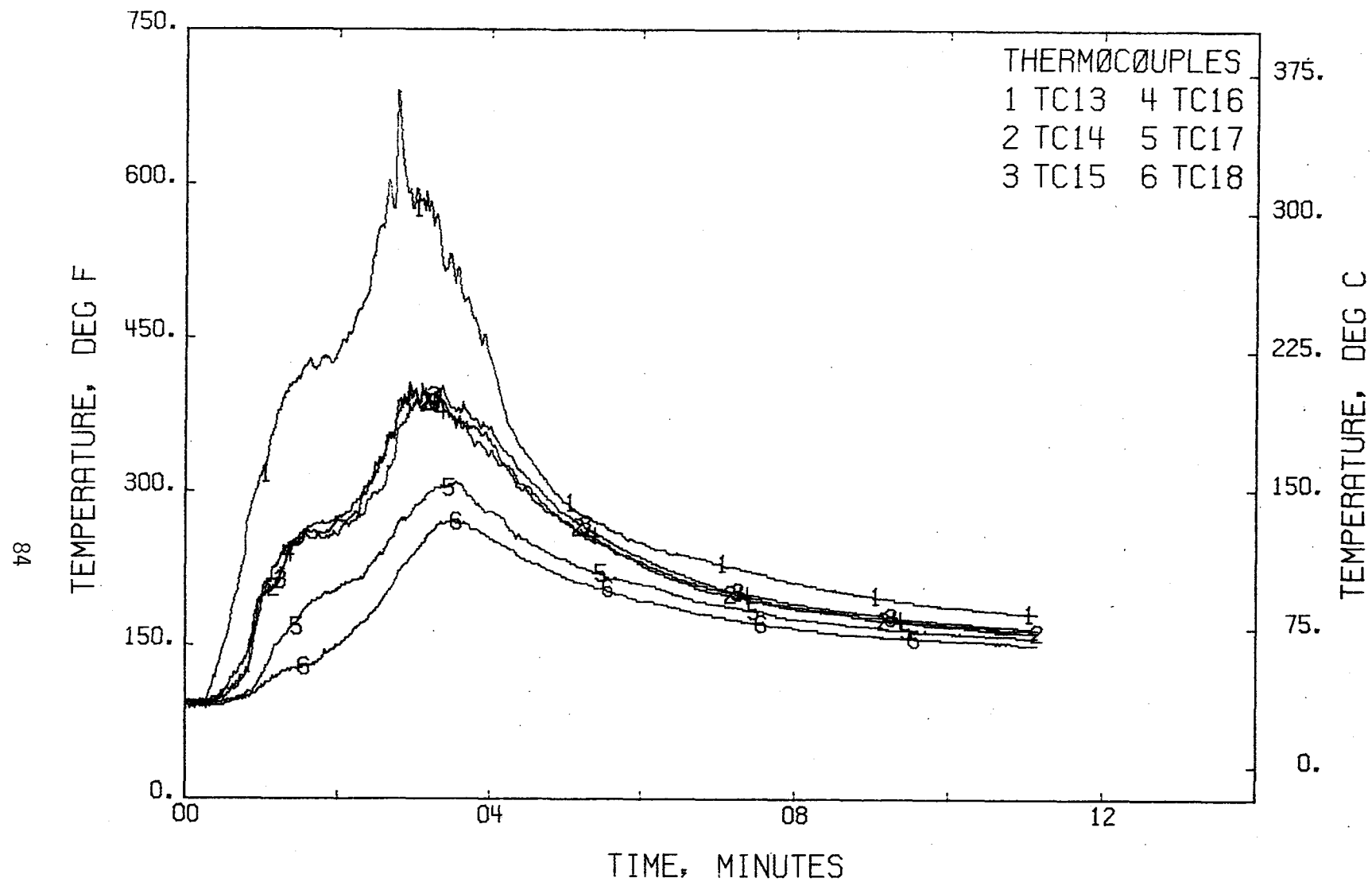


FIGURE 48 . - TEMPERATURES, T/C TREE 3  
TEST 2

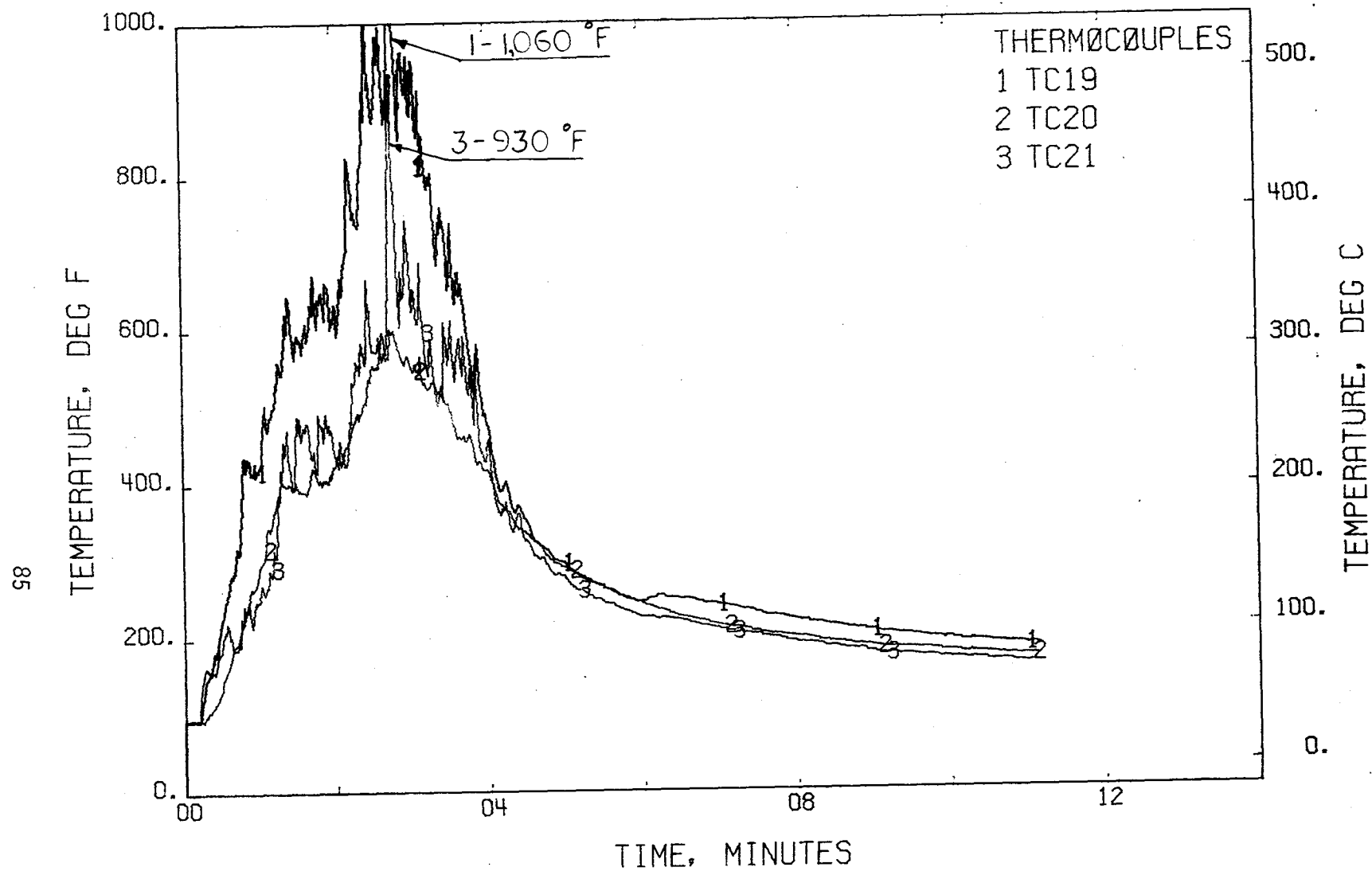


FIGURE 49 . - TEMPERATURES, T/C TREE 4  
TEST 2

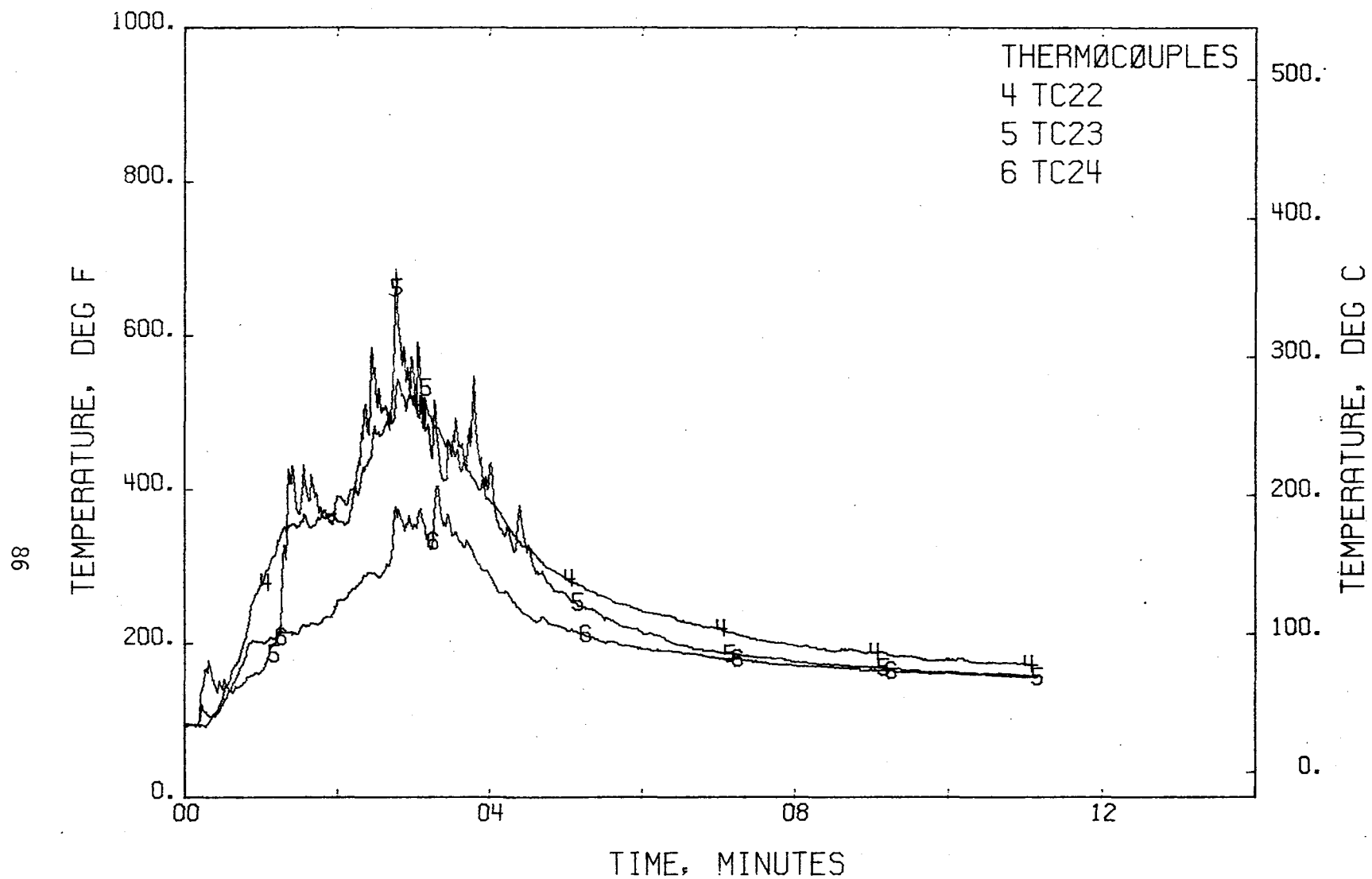


FIGURE 49 . - TEMPERATURES, T/C TREE 4 - CONTINUED  
TEST 2

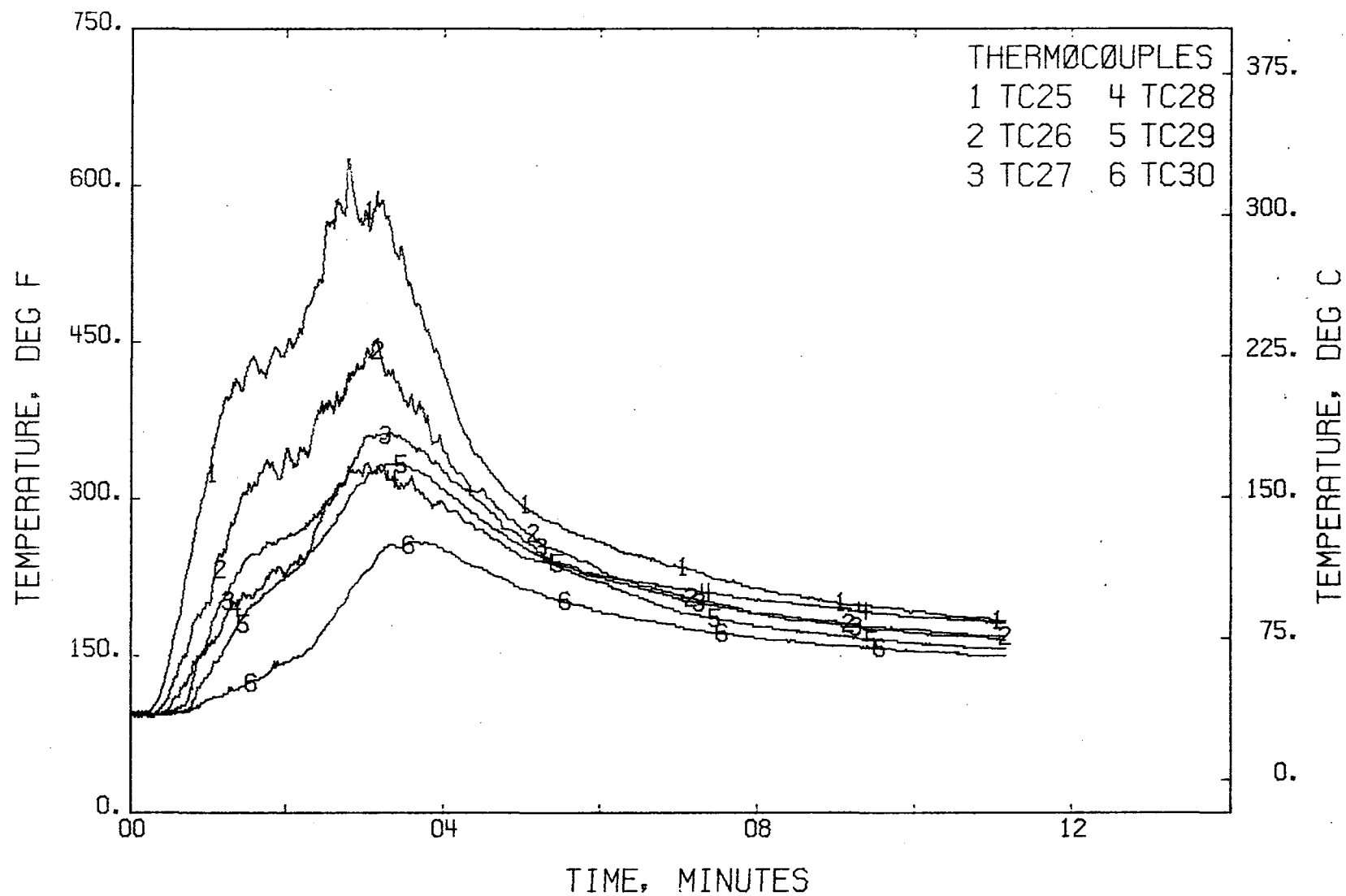


FIGURE 50 . - TEMPERATURES, T/C TREE 5  
TEST 2

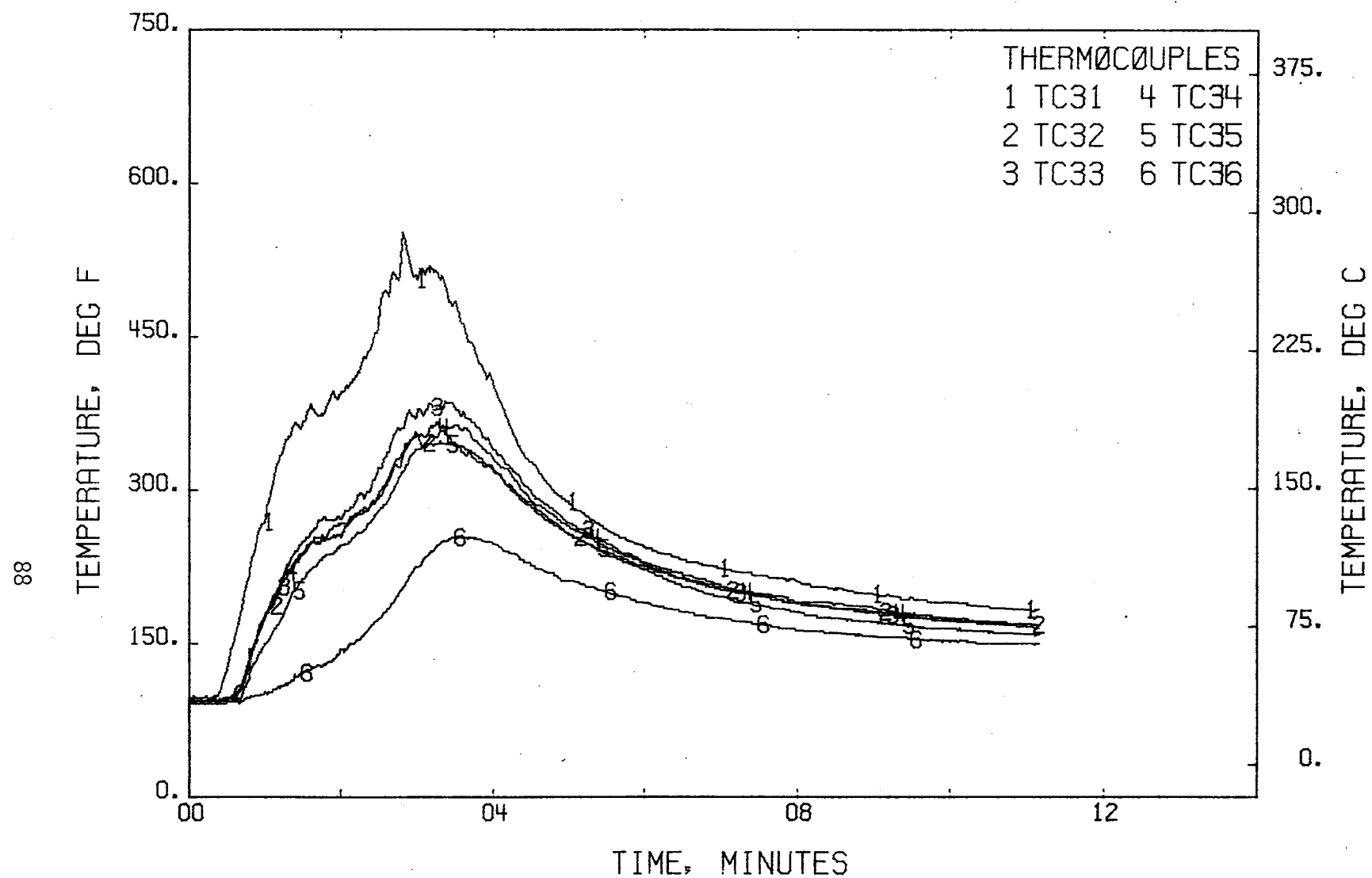


FIGURE 51 . - TEMPERATURES, T/C TREE 6  
TEST 2



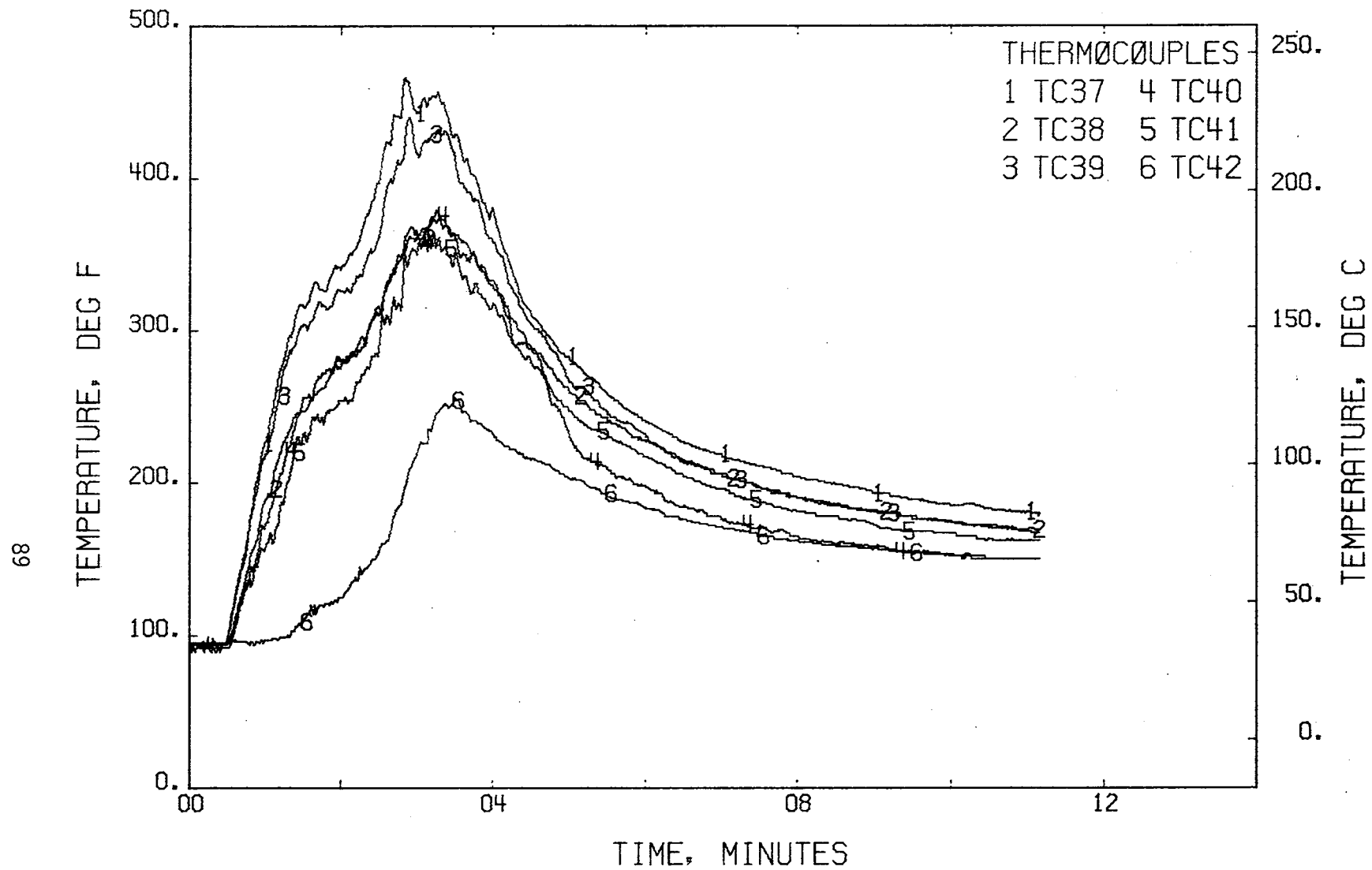


FIGURE 52 . - TEMPERATURES, T/C TREE 7  
TEST 2

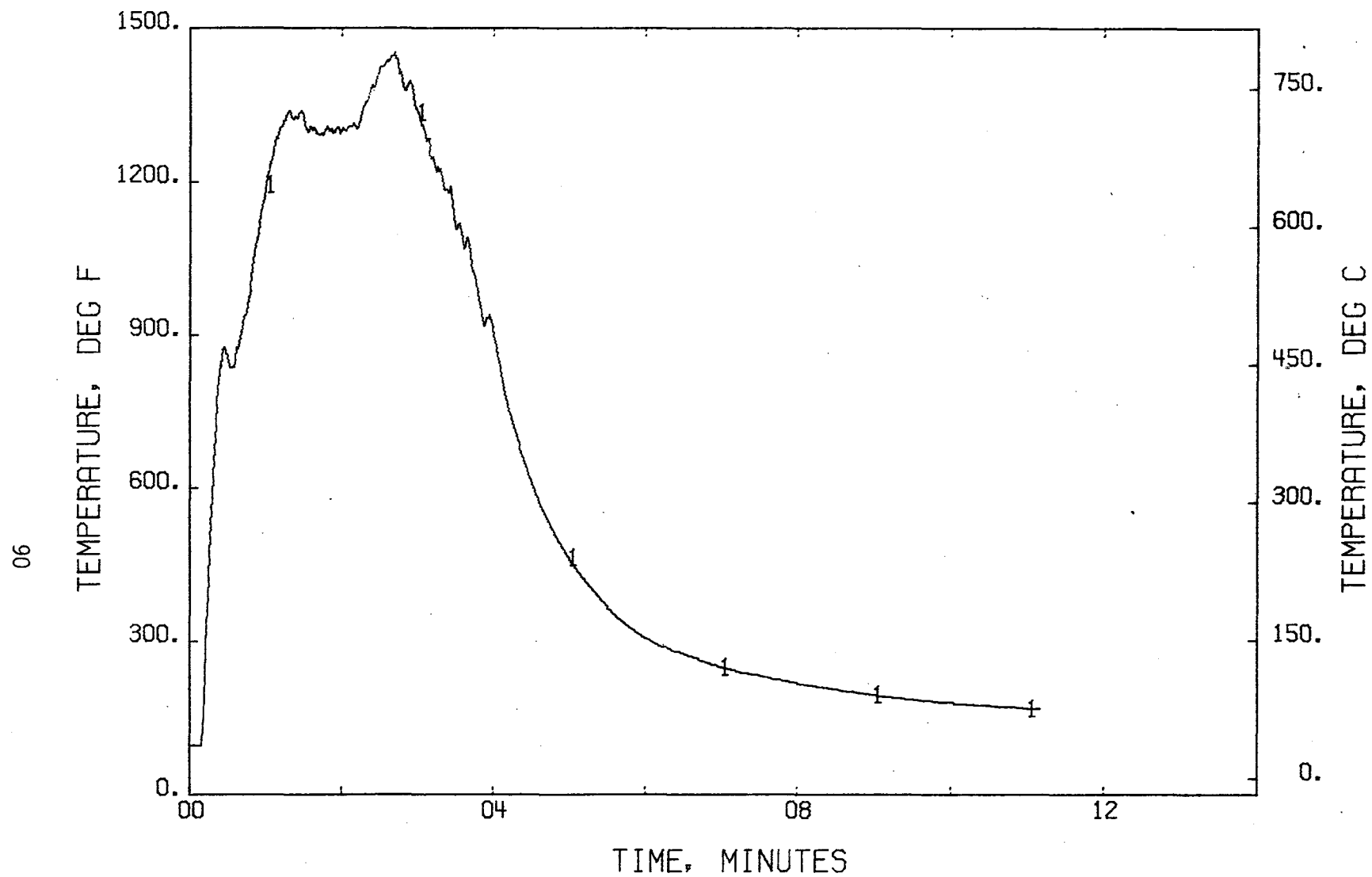


FIGURE 53 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 2

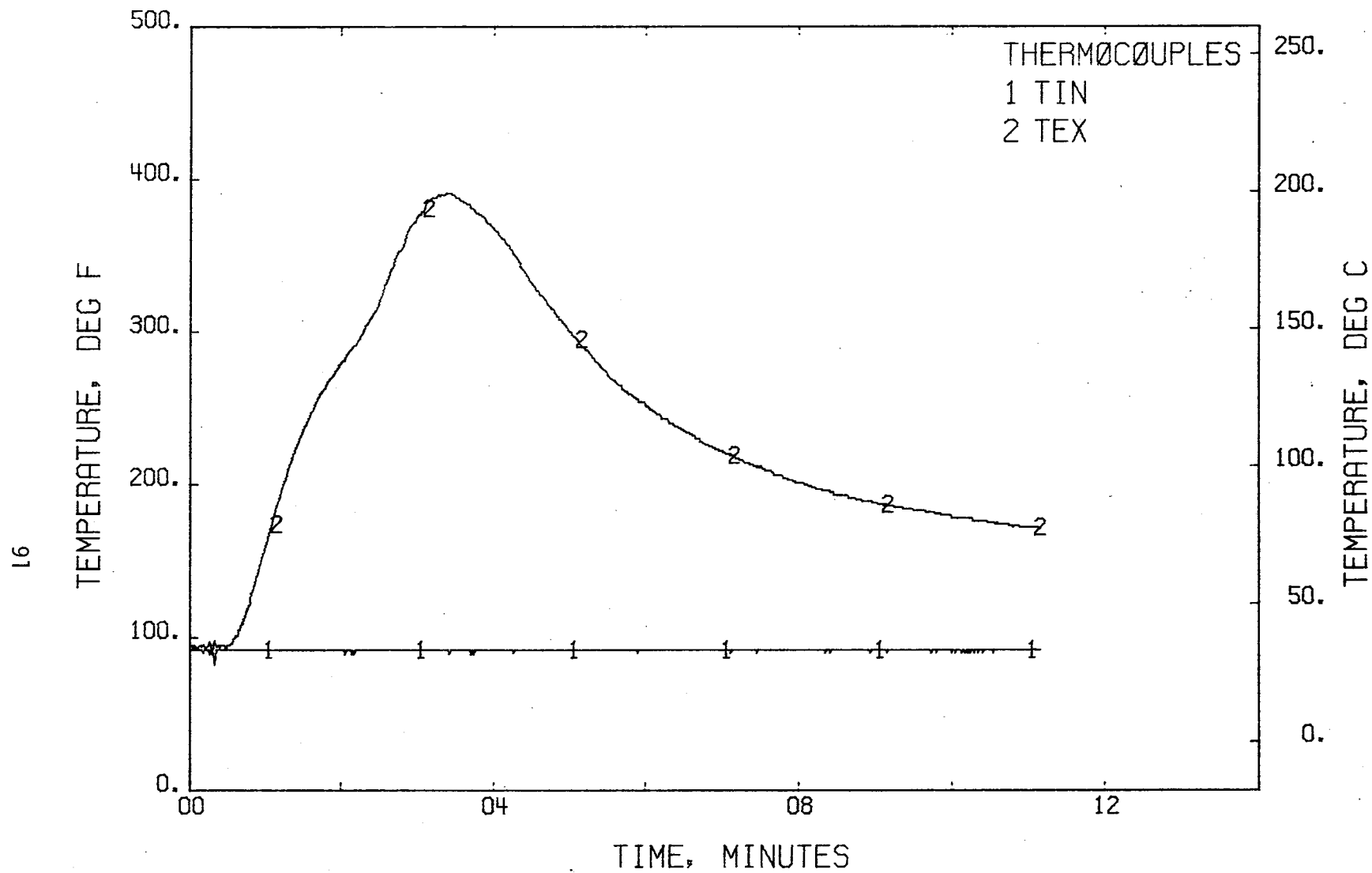


FIGURE 54 . - TEMPERATURES, INLET + EXIT  
TEST 2

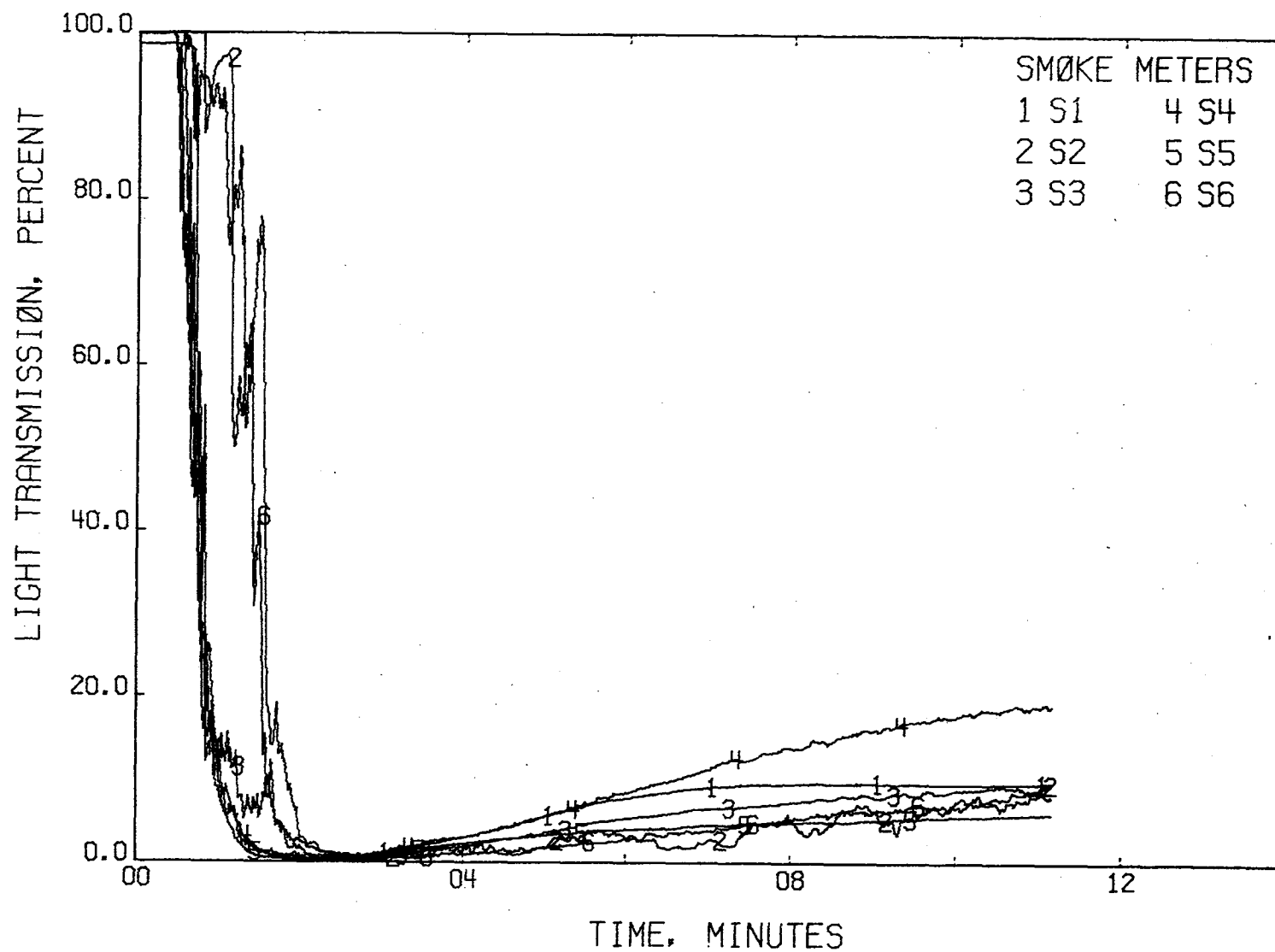


FIGURE 55 . - LIGHT TRANSMISSION  
TEST 2

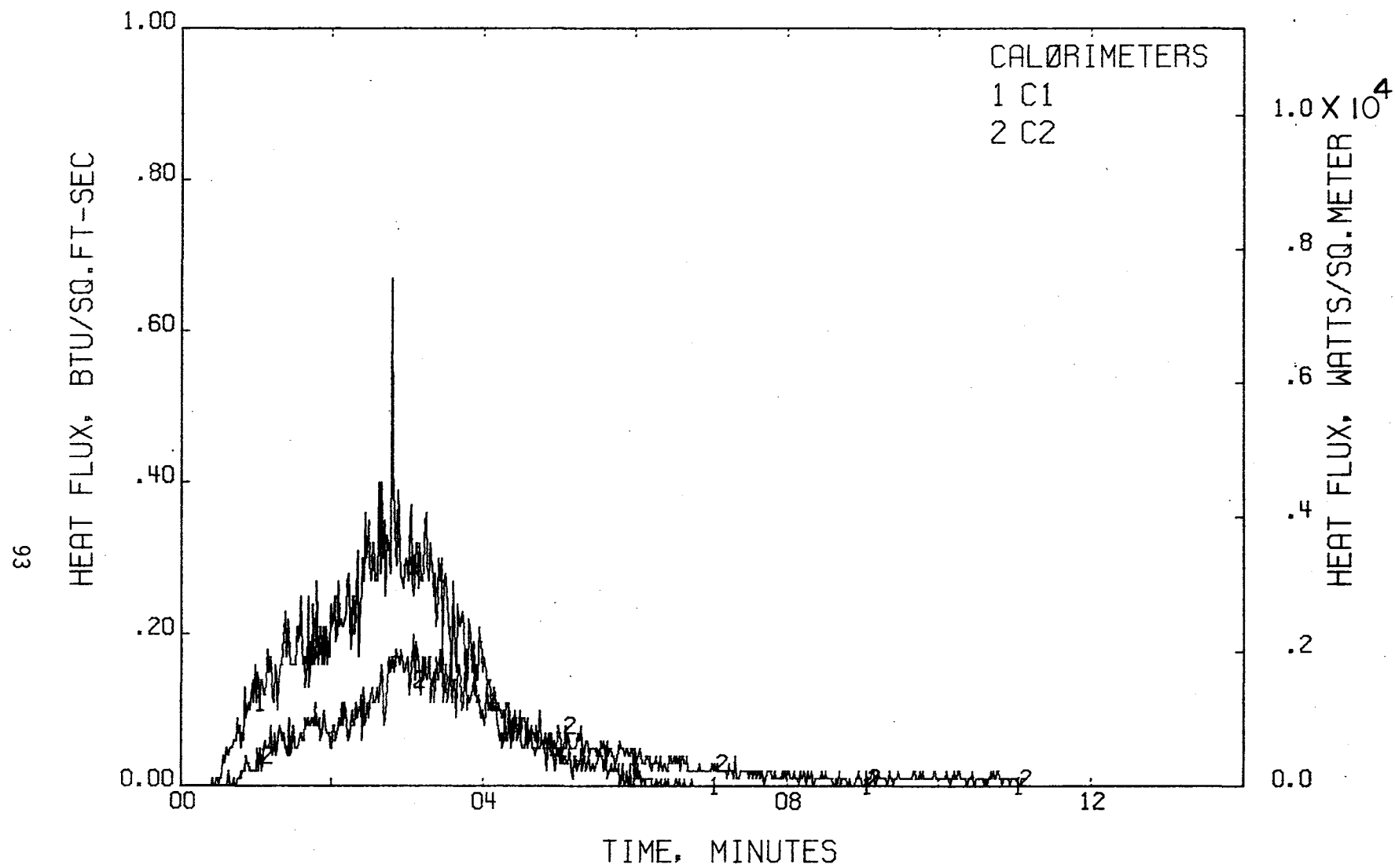


FIGURE 56 . - HEAT FLUX, AFT  
TEST 2

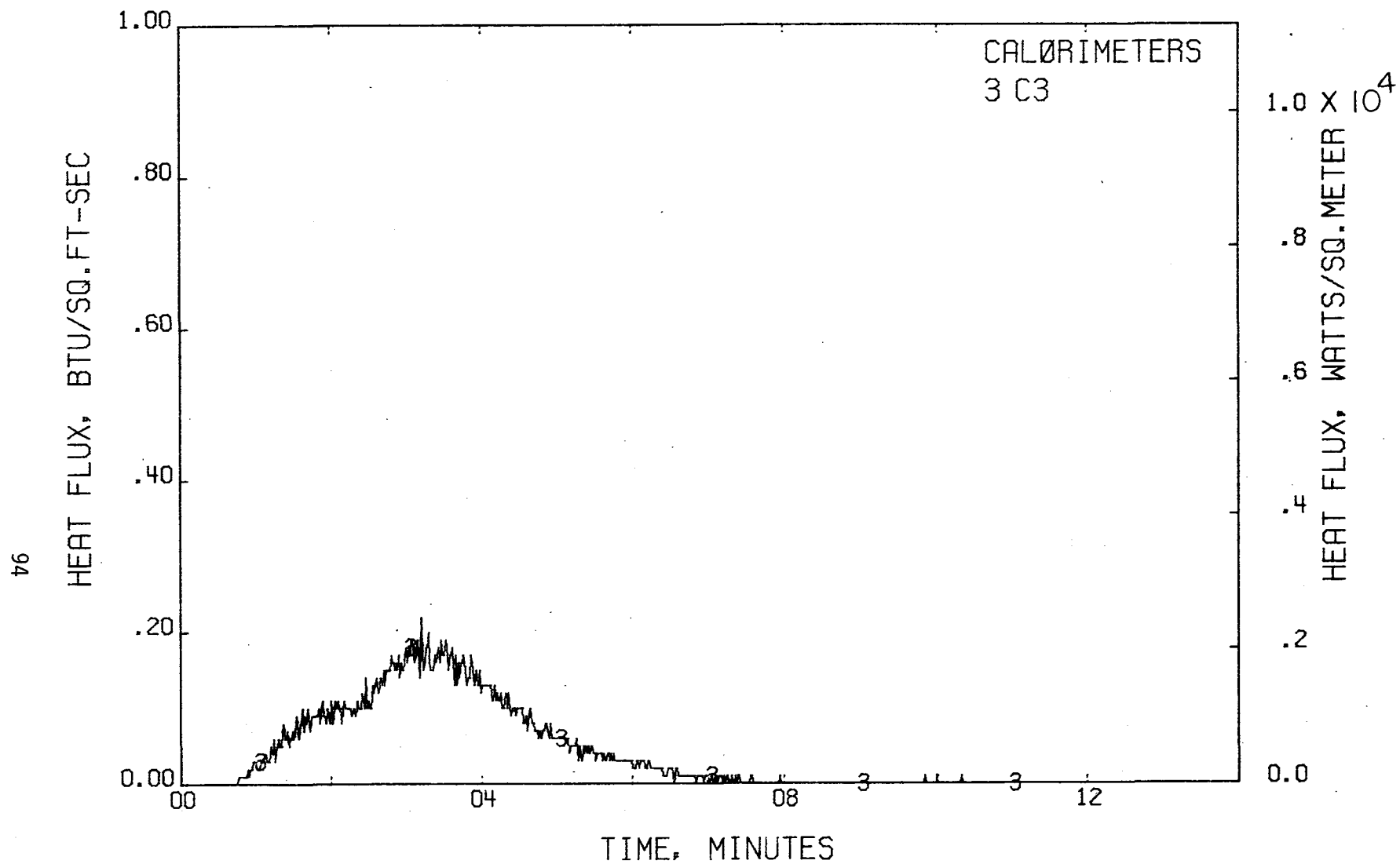


FIGURE 56 . - HEAT FLUX, AFT - CONT.  
TEST 2

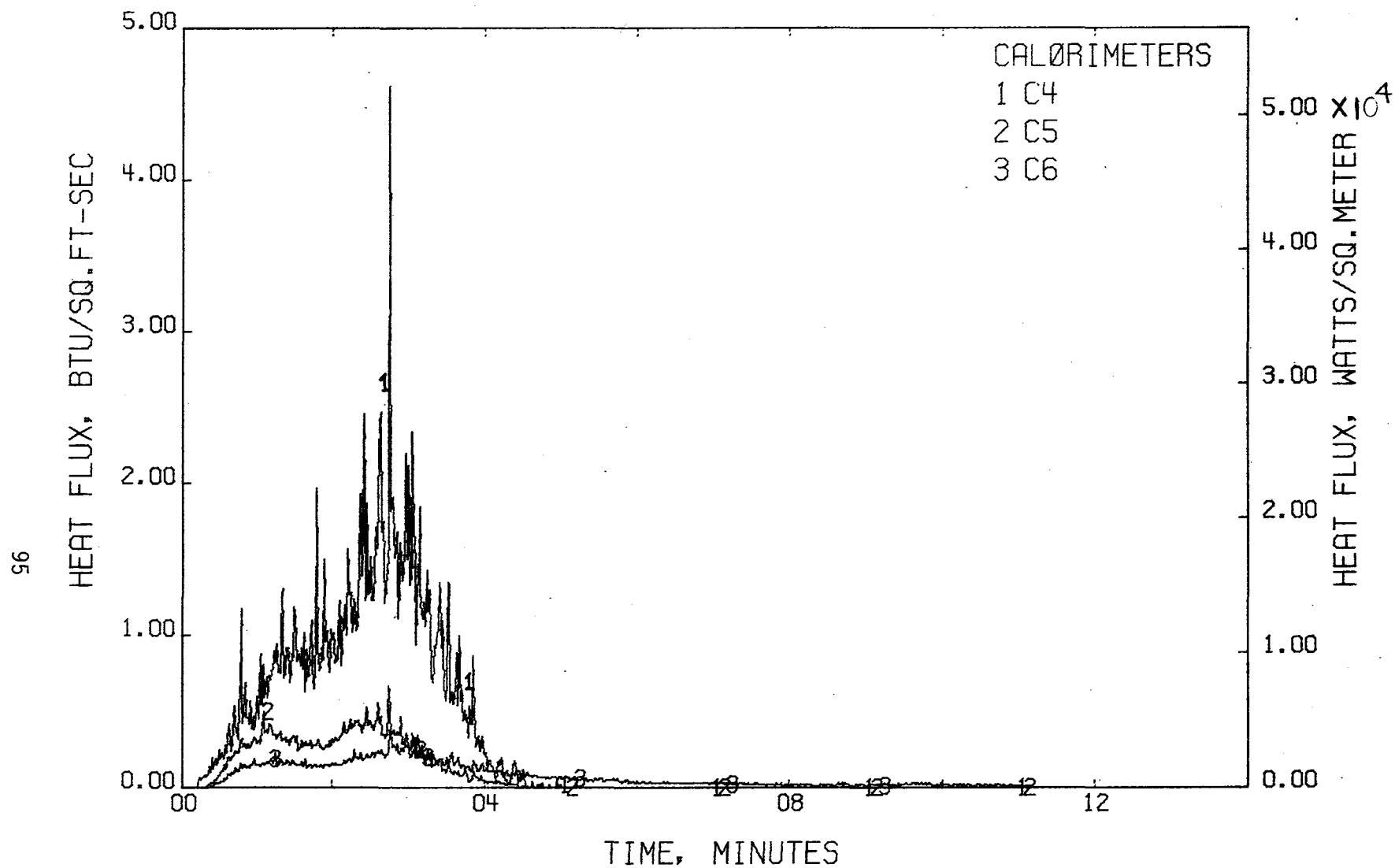
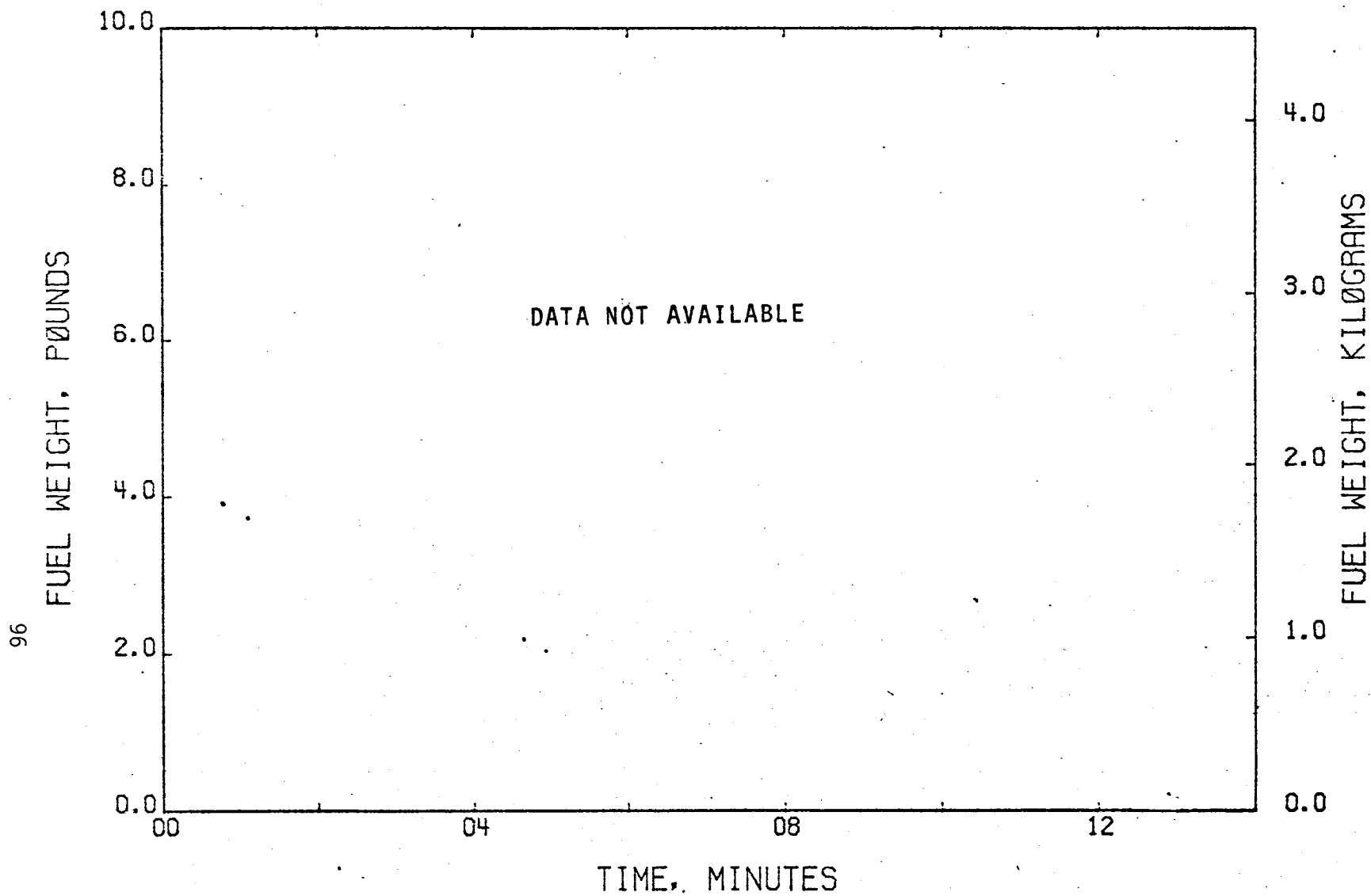


FIGURE 57 . - HEAT FLUX, MIDSECTION  
TEST 2



FUEL WEIGHT LOSS  
TEST 2



THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST

ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM

HYDROGEN FLUORIDE - <12 PPM

HYDROGEN CHLORIDE - <24 PPM

FIGURE 58 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 2

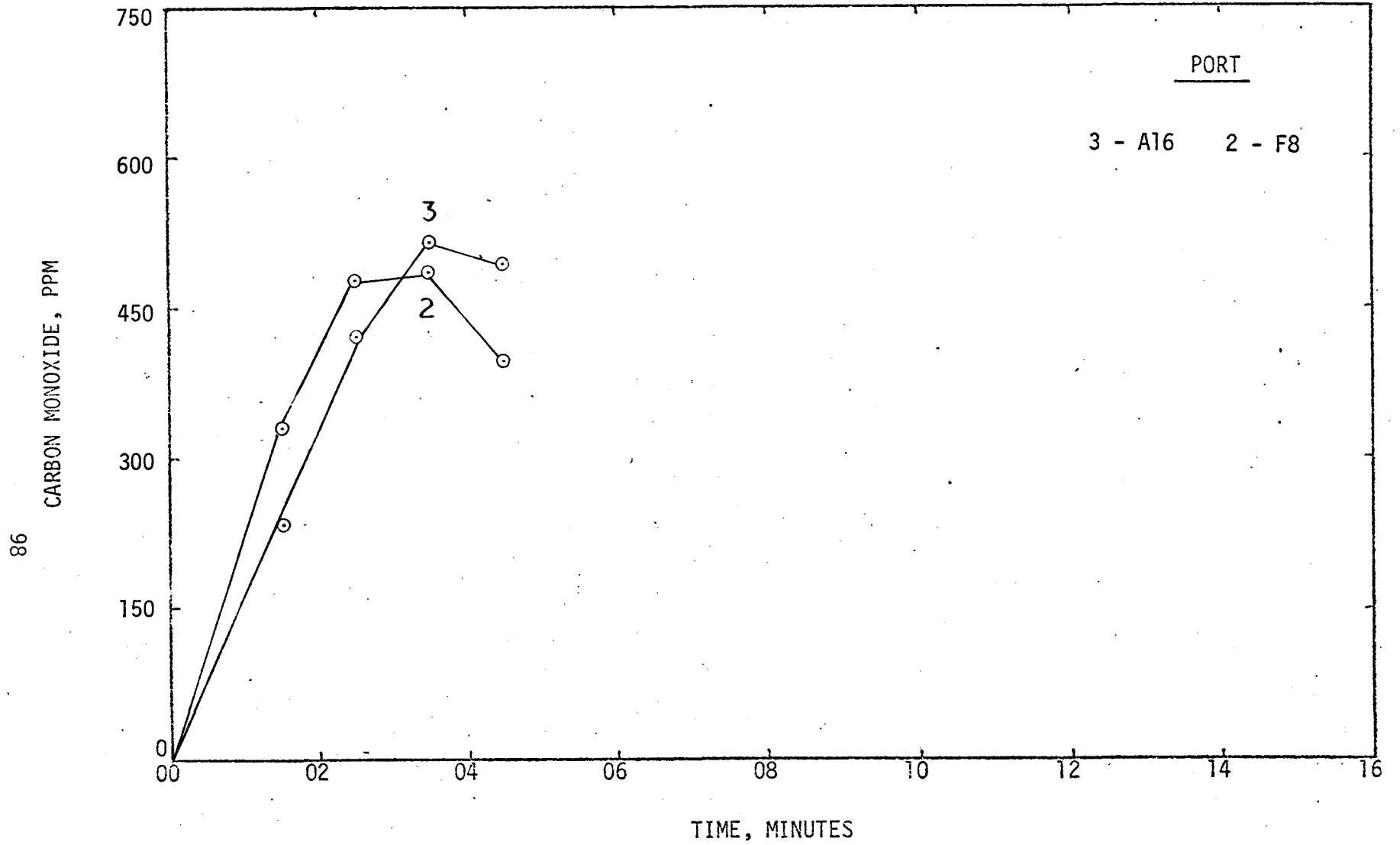


FIGURE 59 - CARBON MONOXIDE CONCENTRATIONS  
TEST 2

CARBON DIOXIDE, PERCENT

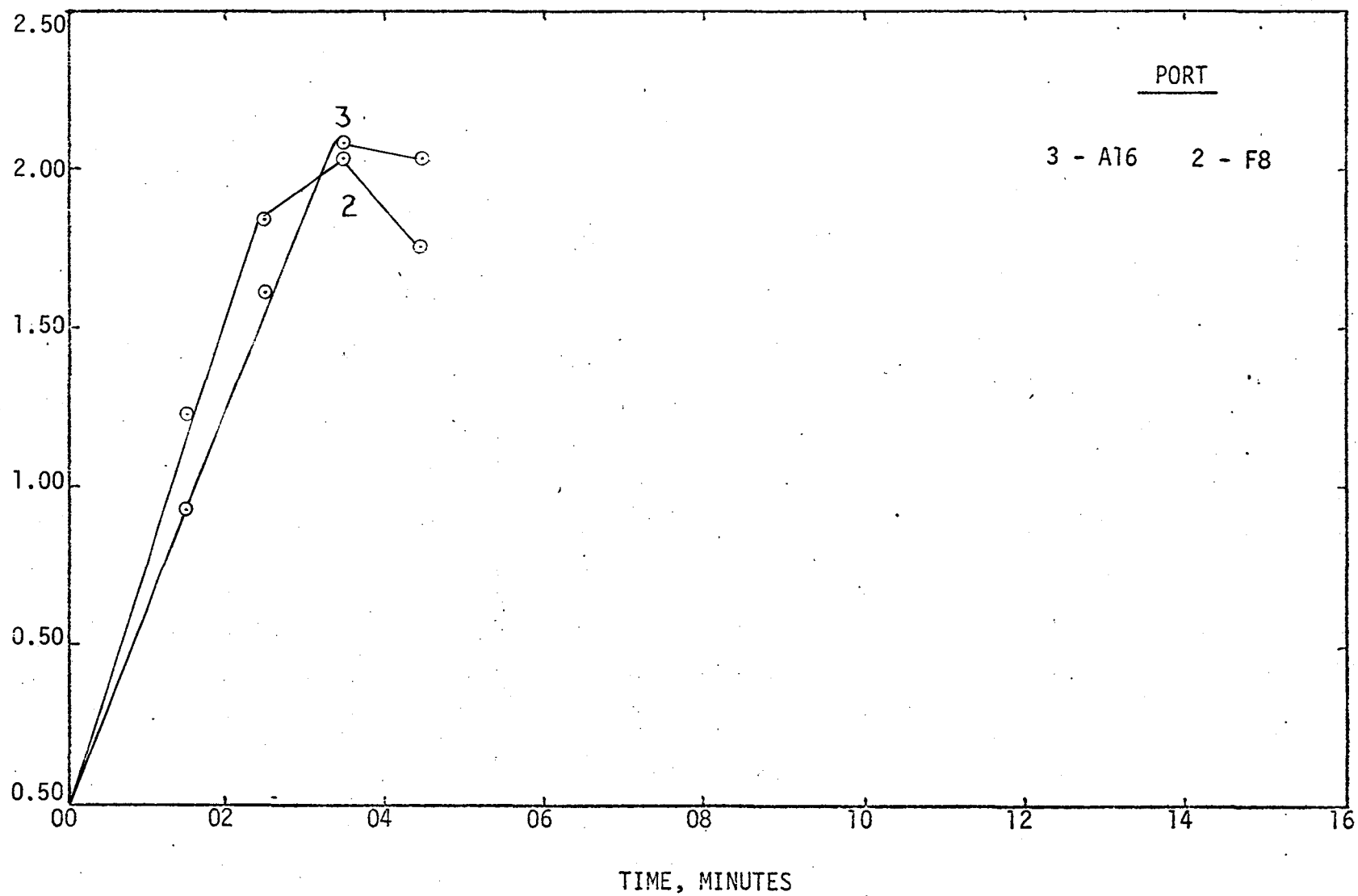


FIGURE 60 - CARBON DIOXIDE CONCENTRATIONS  
TEST 2

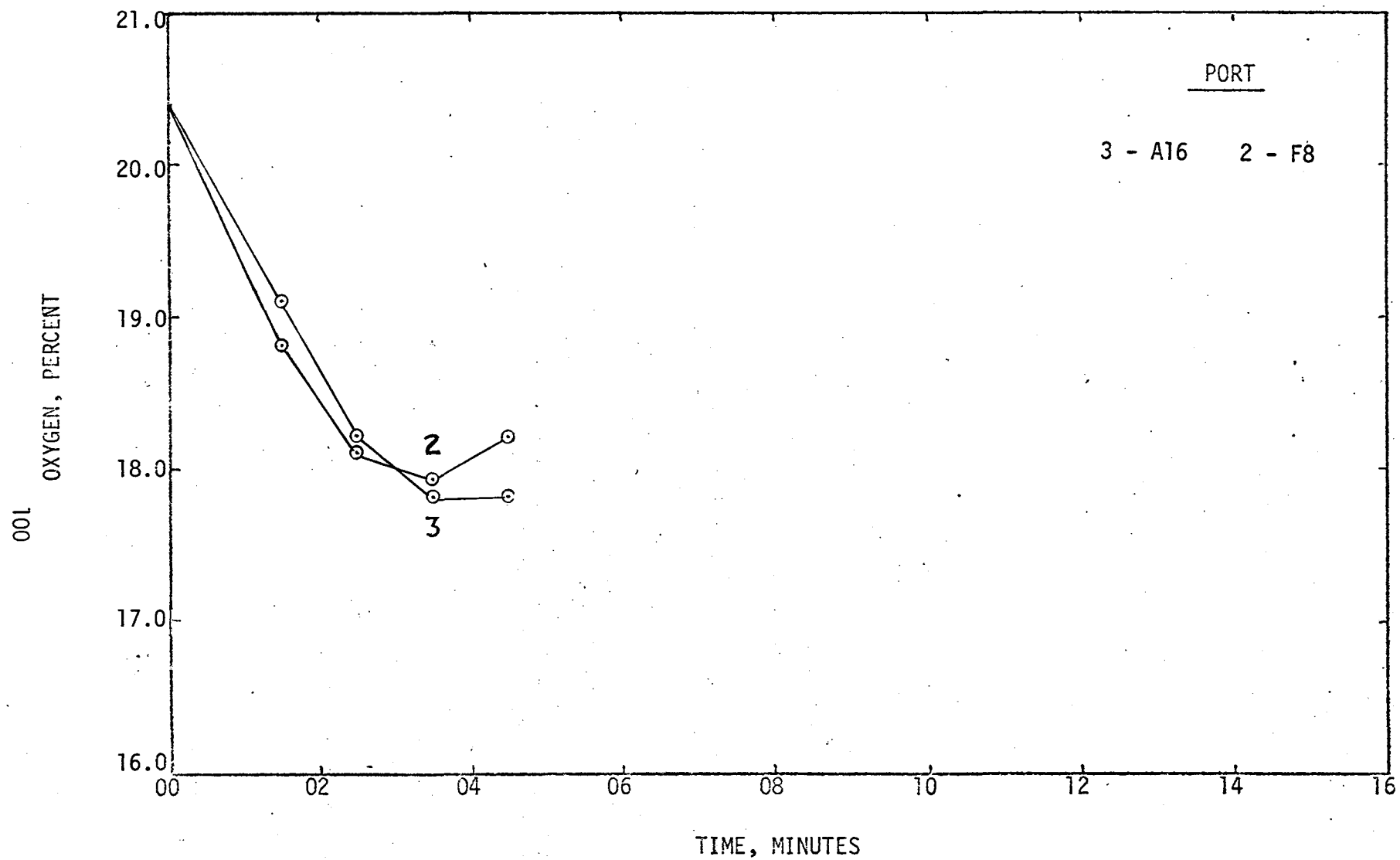


FIGURE 61 . - OXYGEN CONCENTRATIONS

TEST 2

TEST 3

---

FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 3

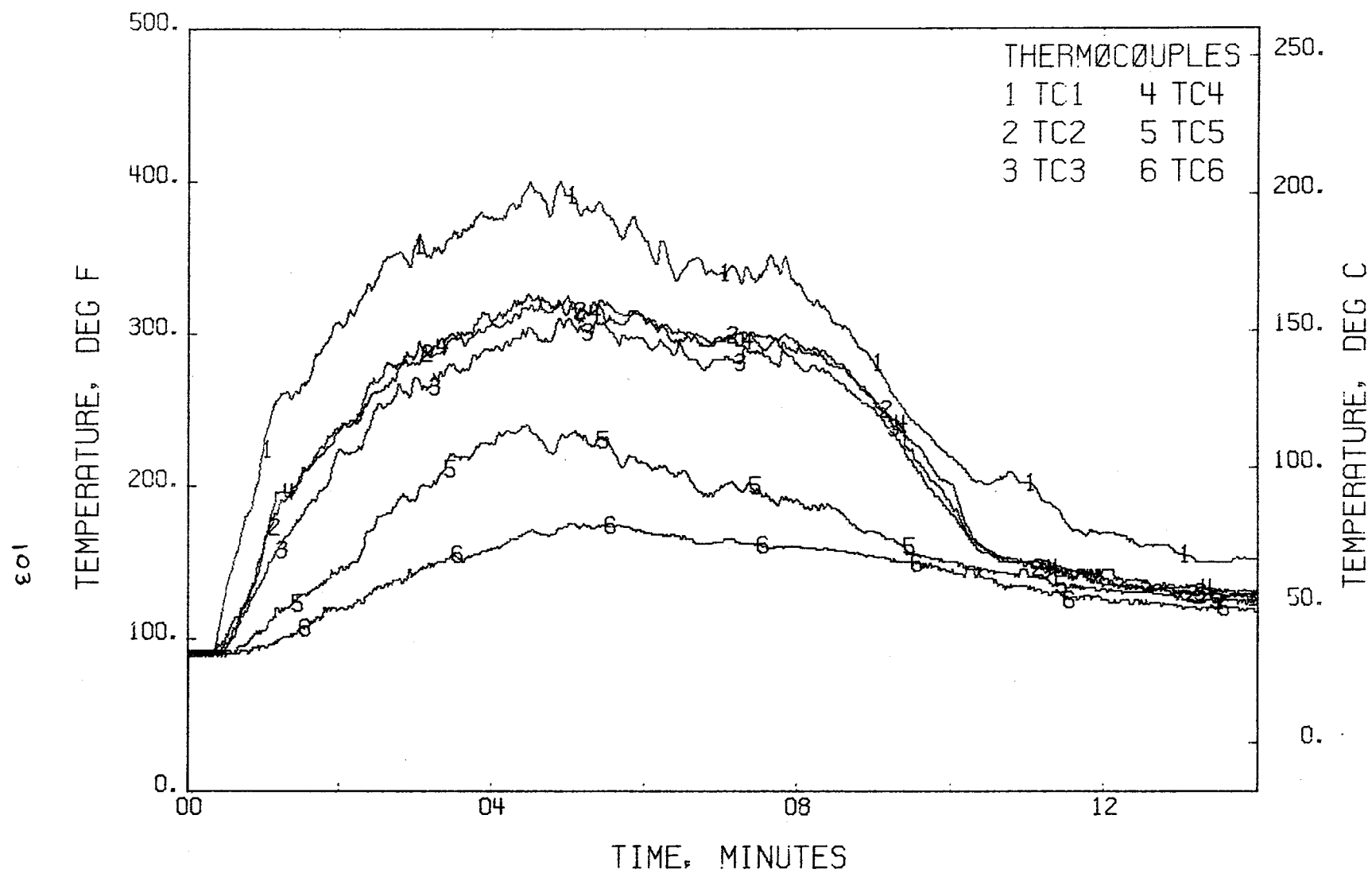


FIGURE 62 . - TEMPERATURES, T/C TREE 1  
TEST 3

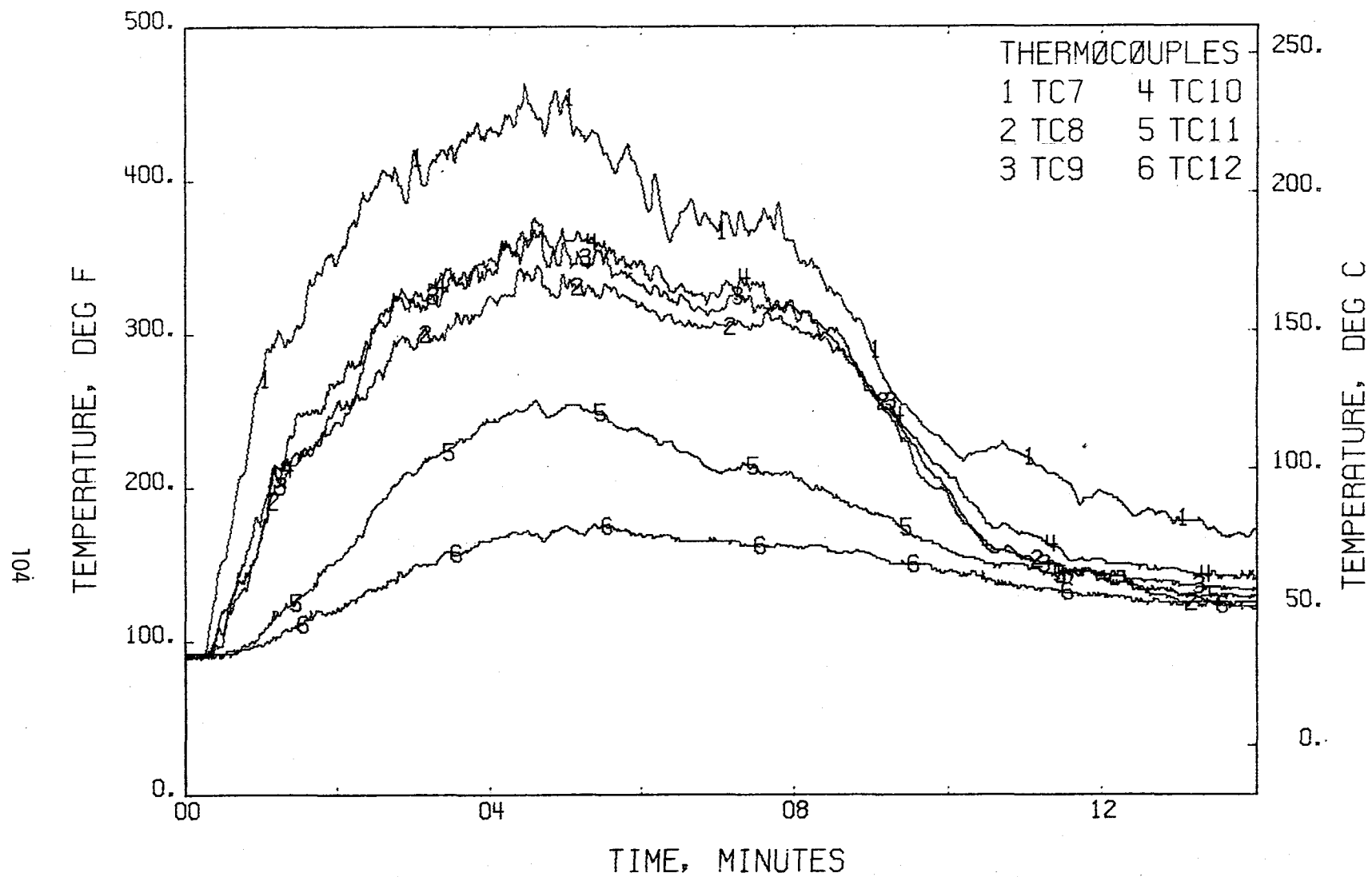


FIGURE 63 . - TEMPERATURES, T/C TREE 2  
TEST 3



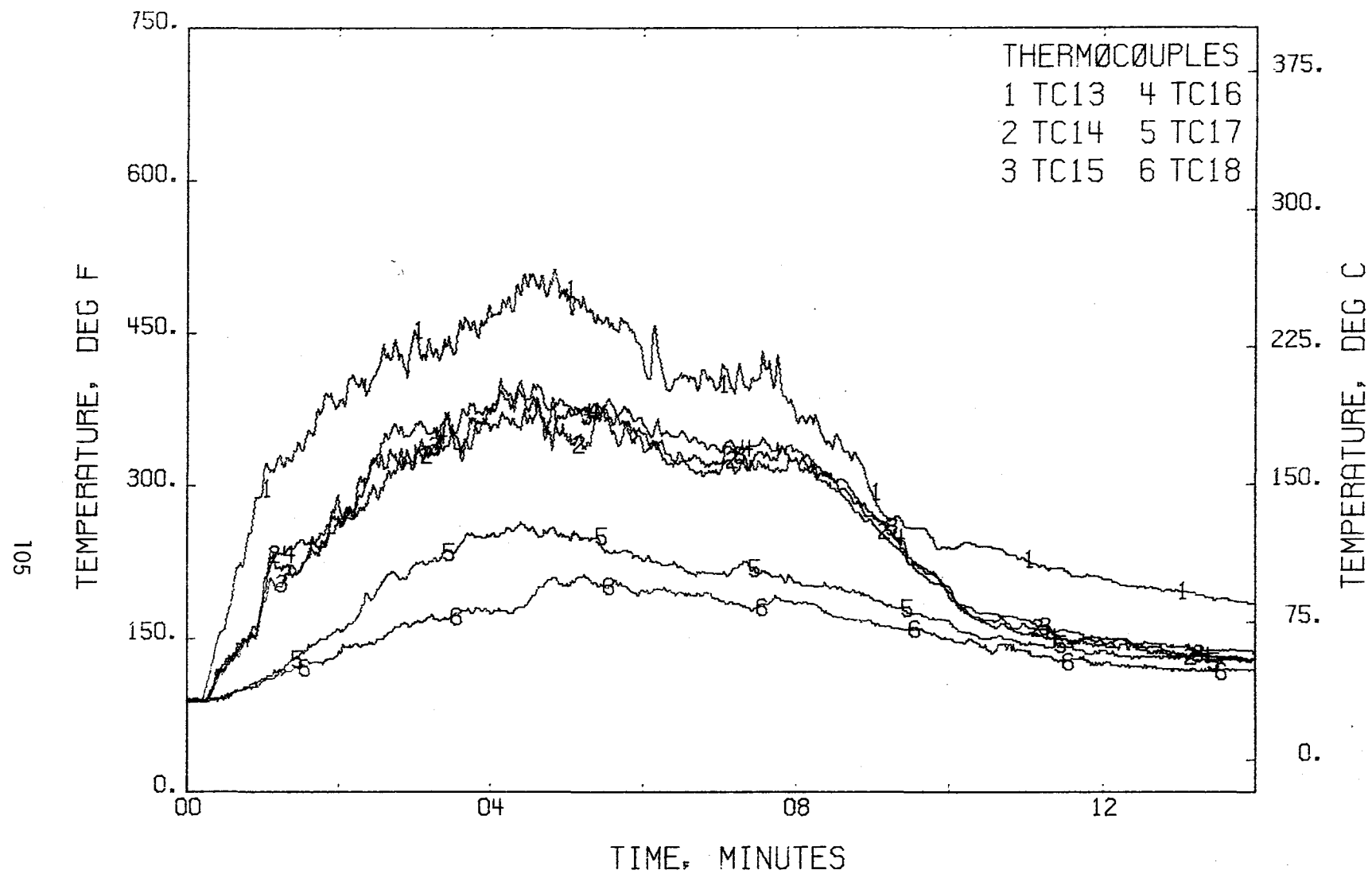


FIGURE 64 . - TEMPERATURES, T/C TREE 3  
TEST 3

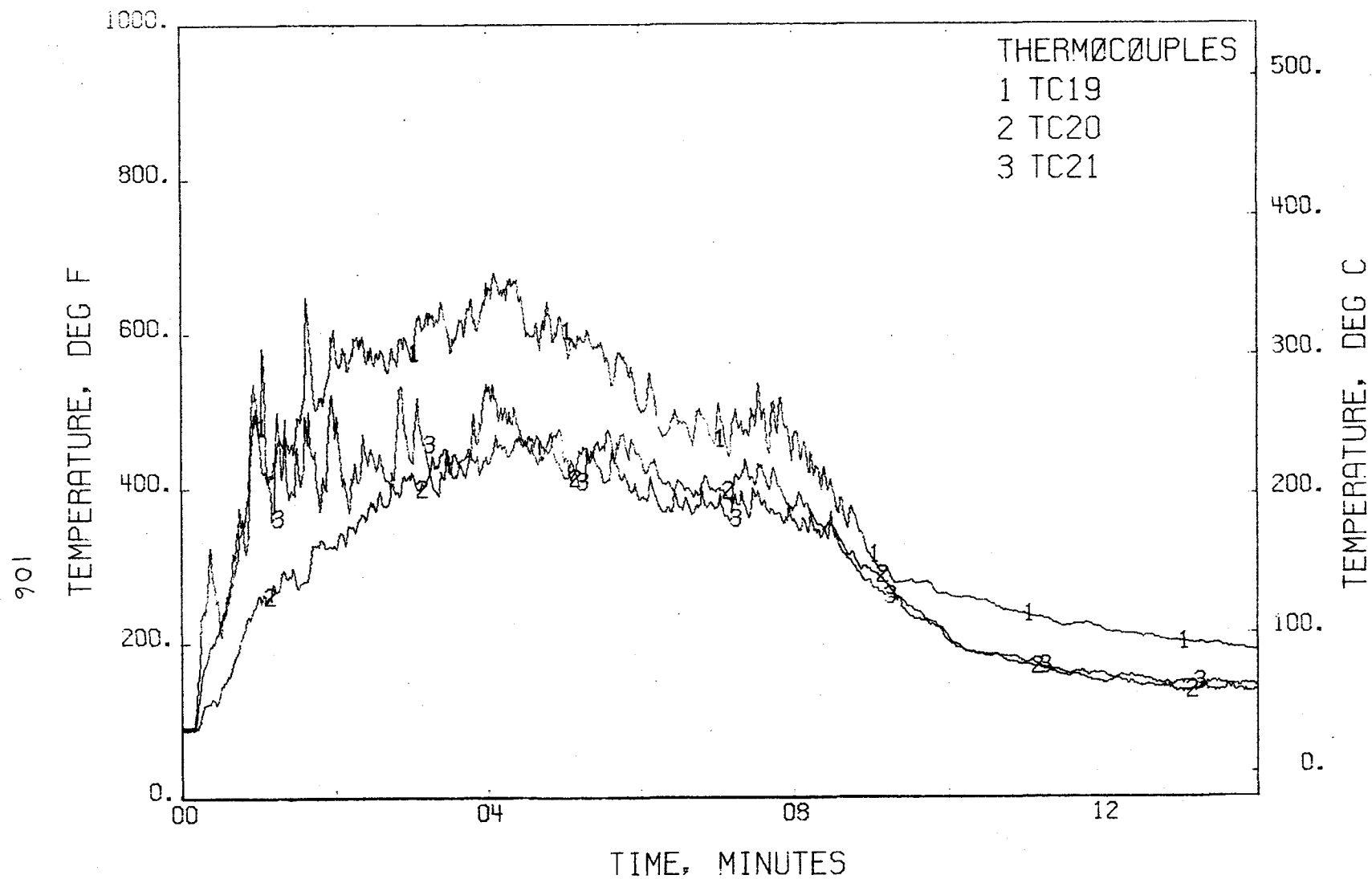


FIGURE 65 . - TEMPERATURES, T/C TREE 4  
TEST 3

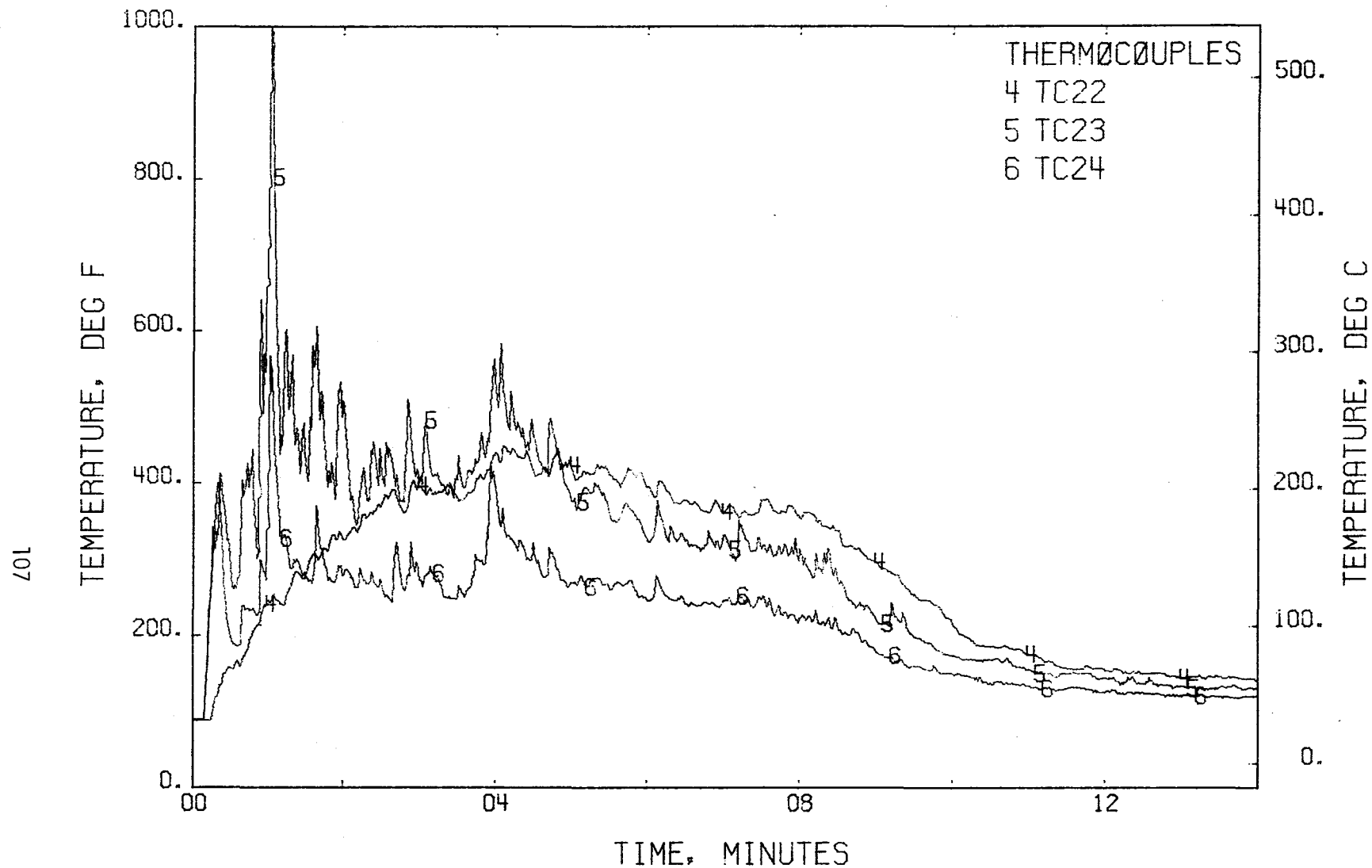


FIGURE 65 . - TEMPERATURES, T/C TREE 4 - CONTINUED  
TEST 3

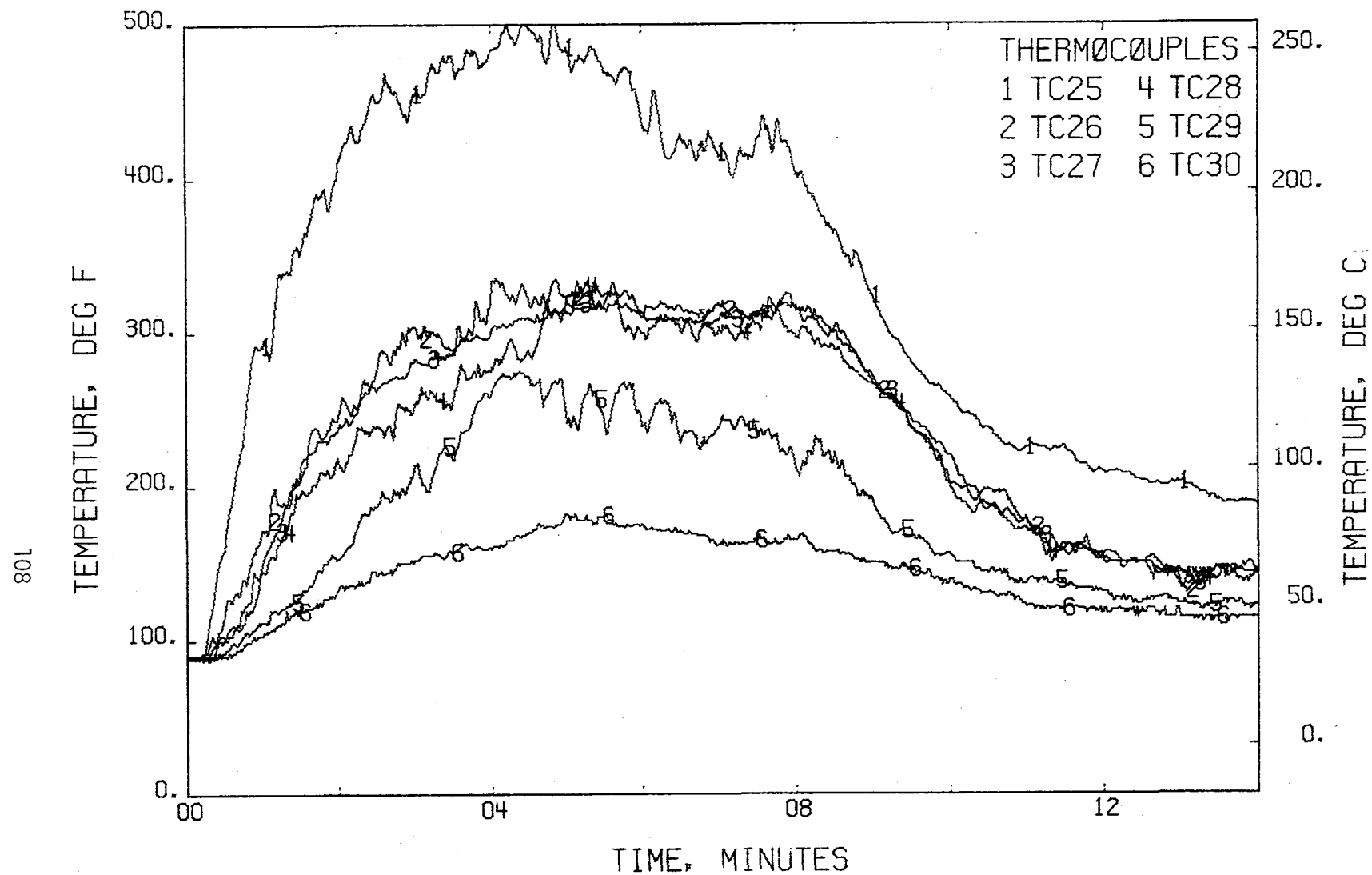


FIGURE 66 . - TEMPERATURES, T/C TREE 5  
TEST 3

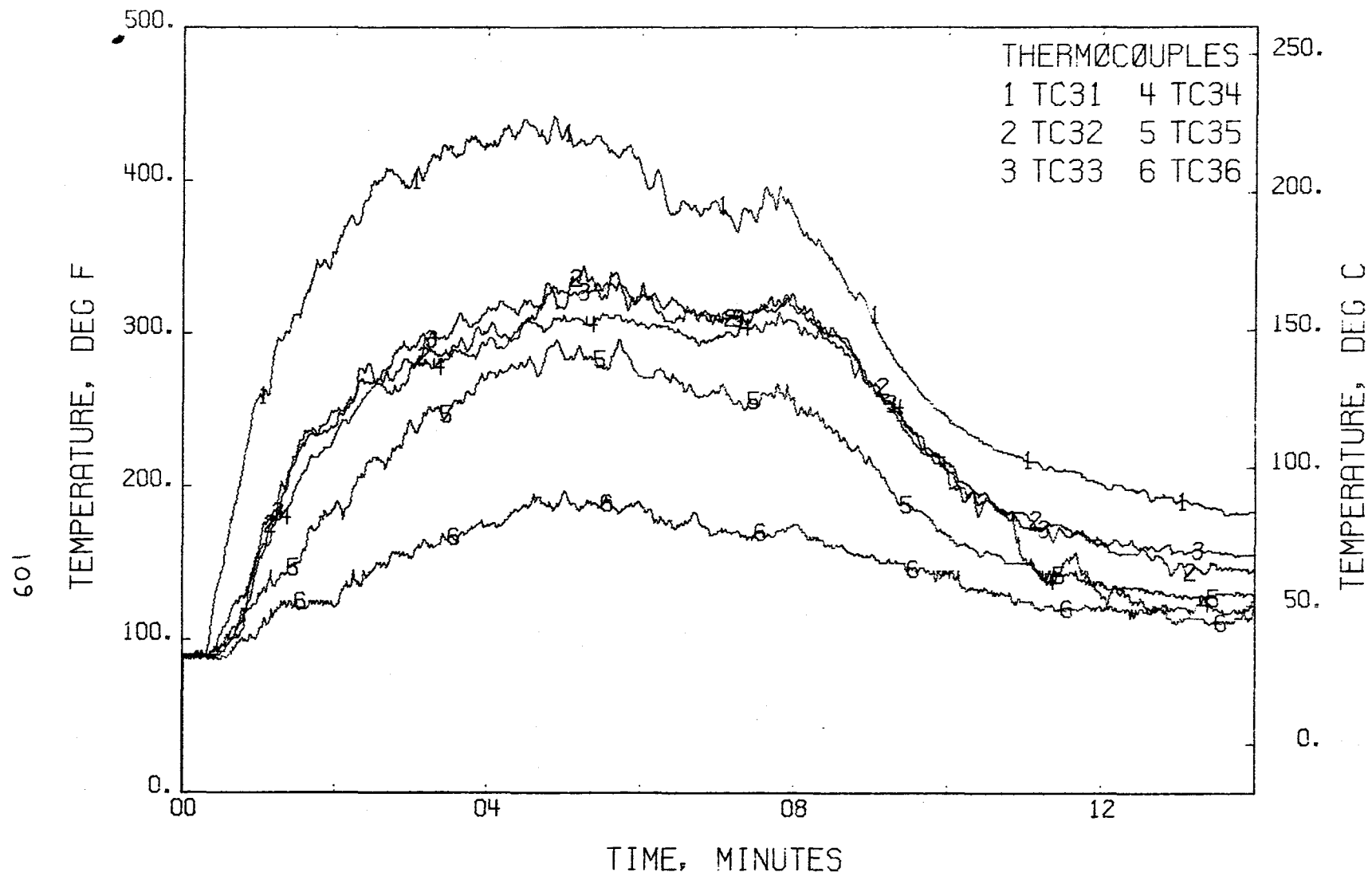


FIGURE 67 . - TEMPERATURES, T/C TREE 6  
TEST 3

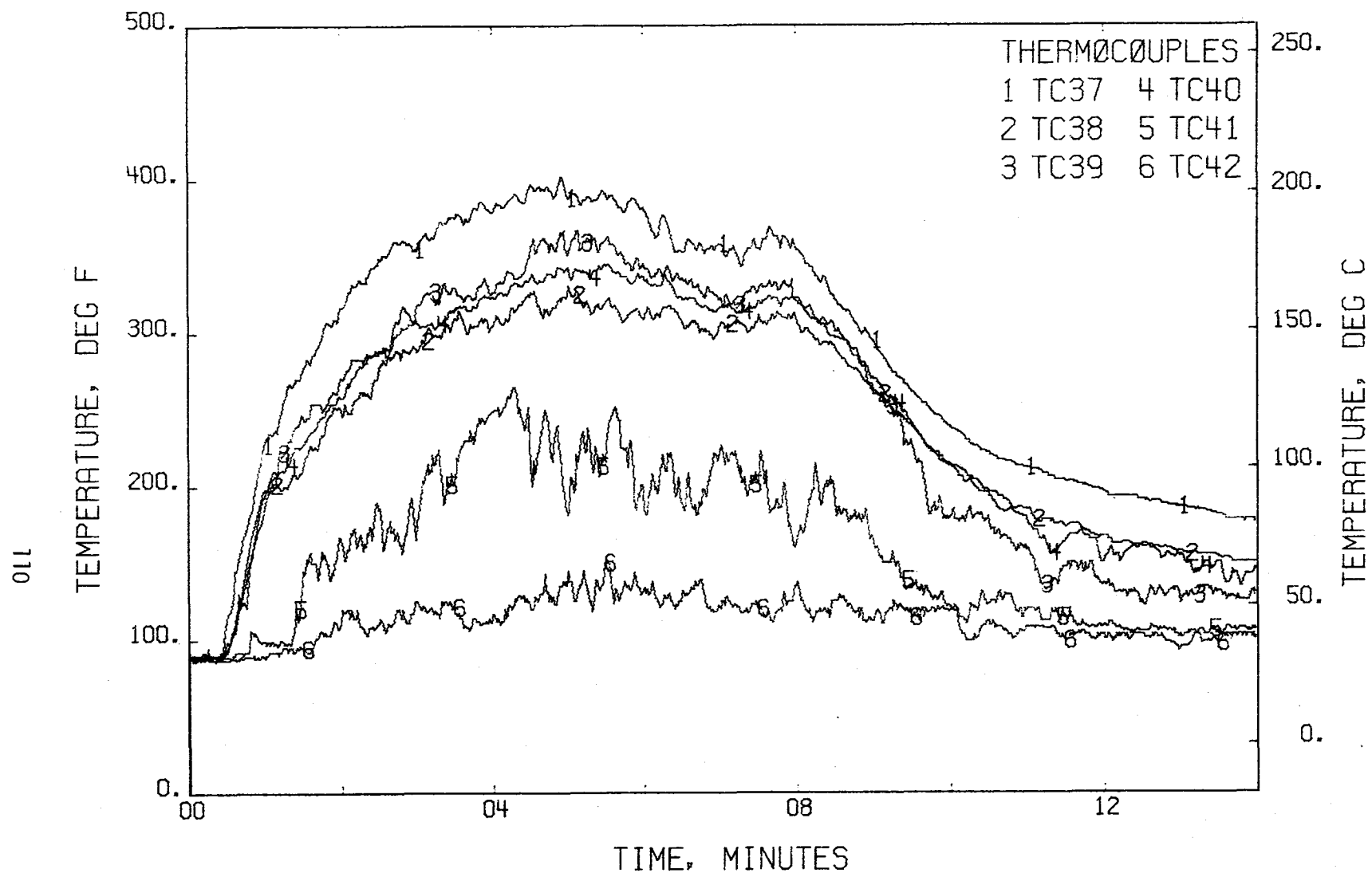


FIGURE 68 . - TEMPERATURES, T/C TREE 7  
TEST 3

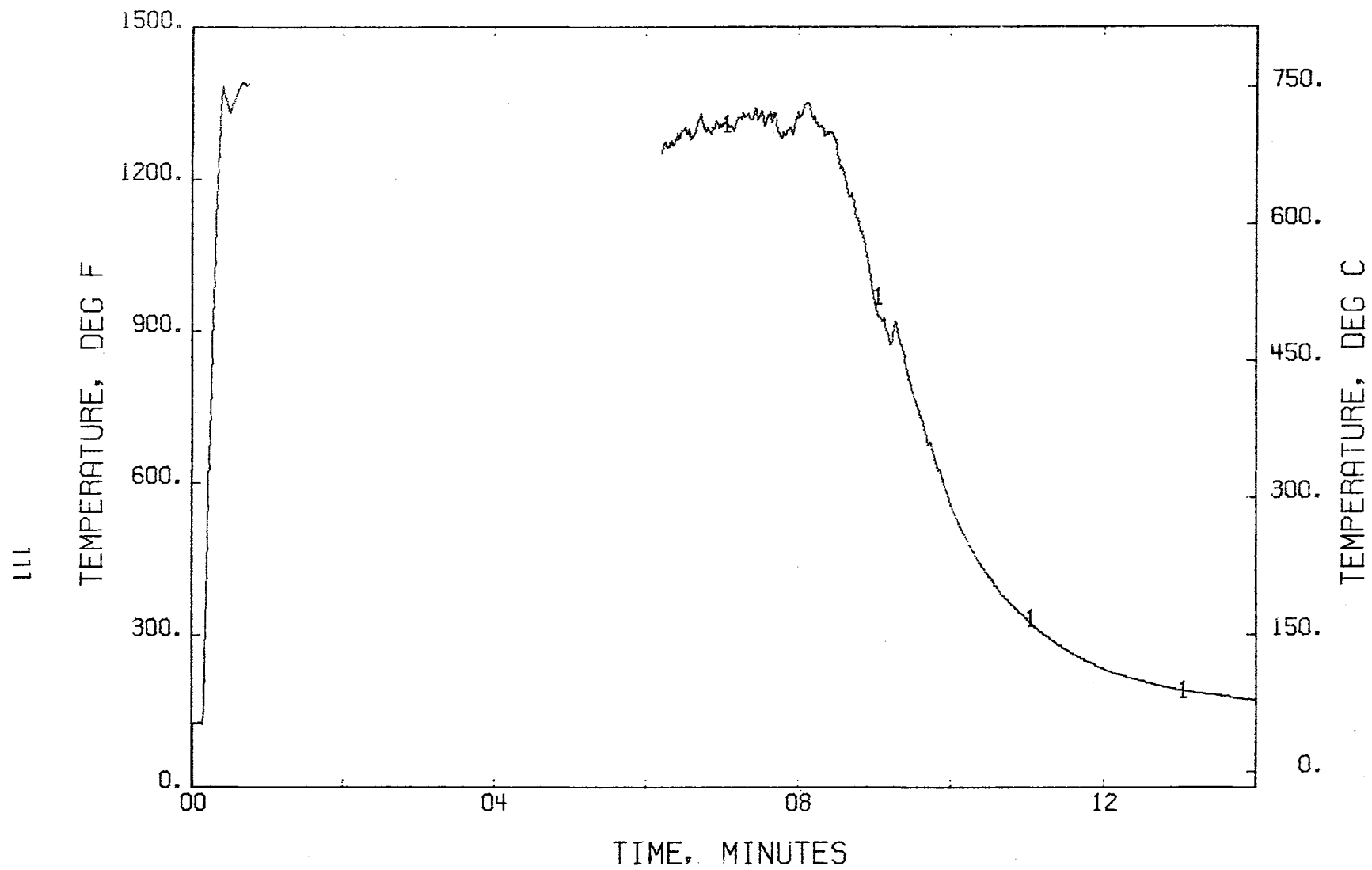


FIGURE 69 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 3

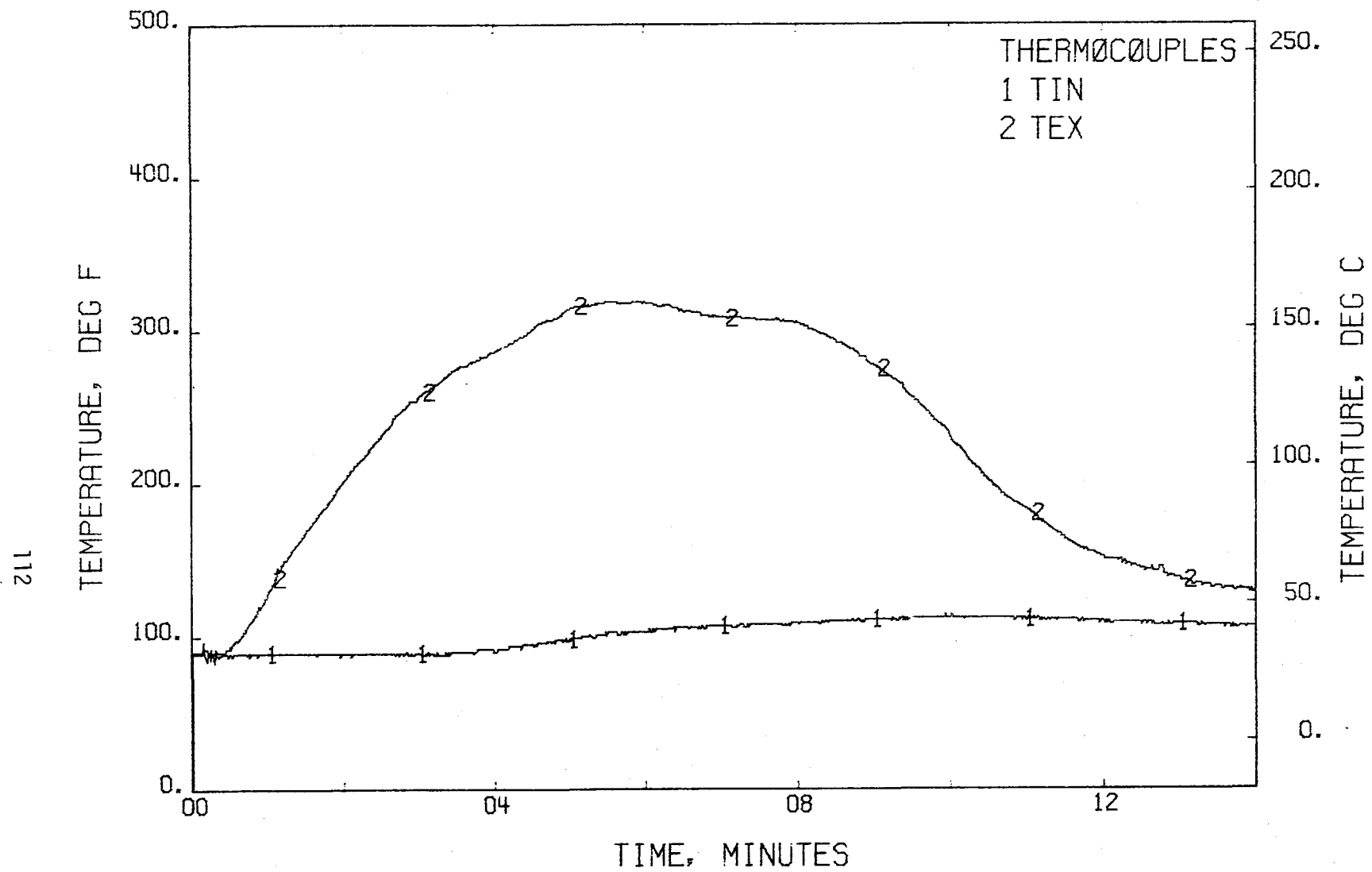


FIGURE 70 . - TEMPERATURES; INLET + EXIT  
TEST 3



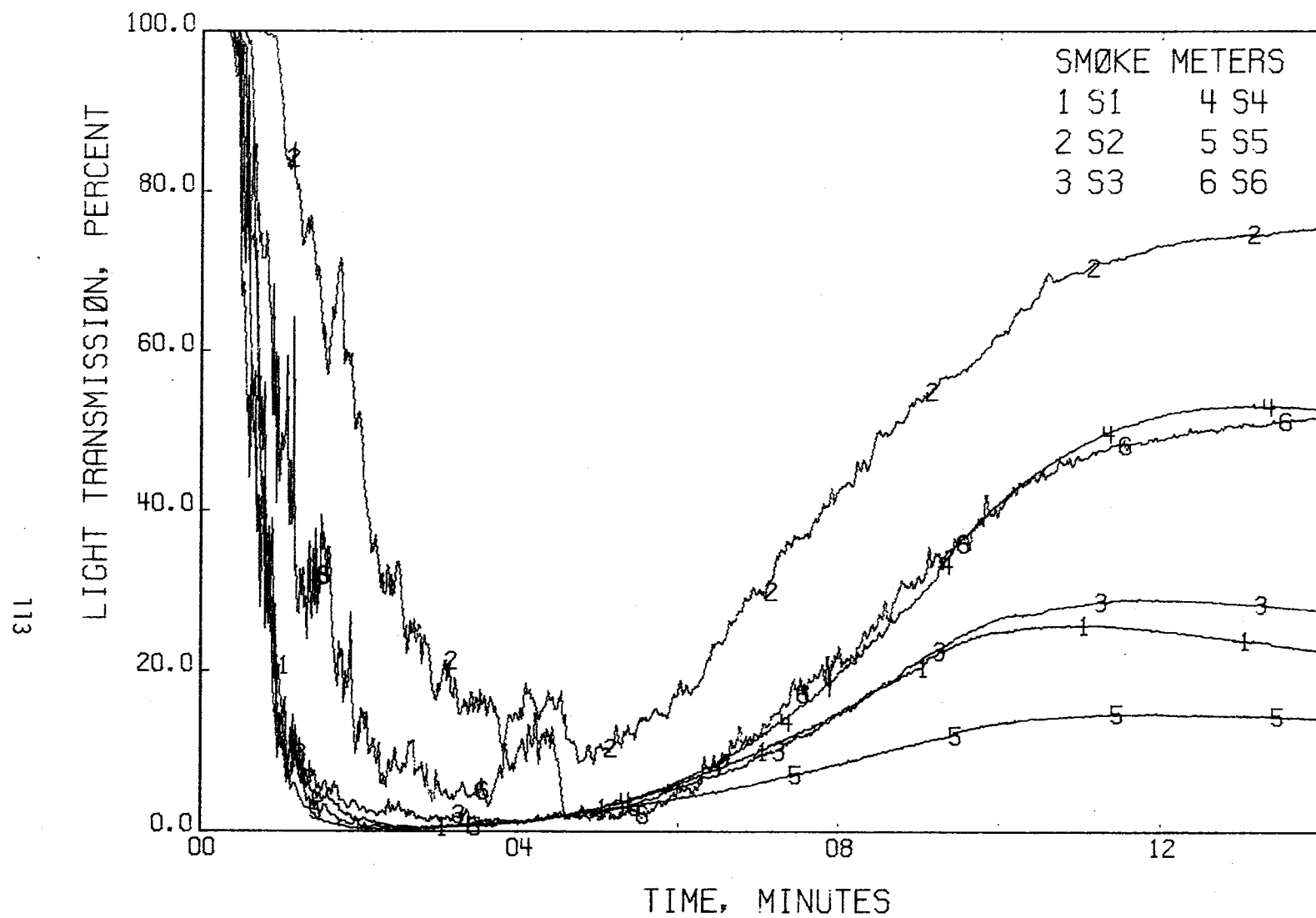


FIGURE 71 . - LIGHT TRANSMISSION  
TEST 3

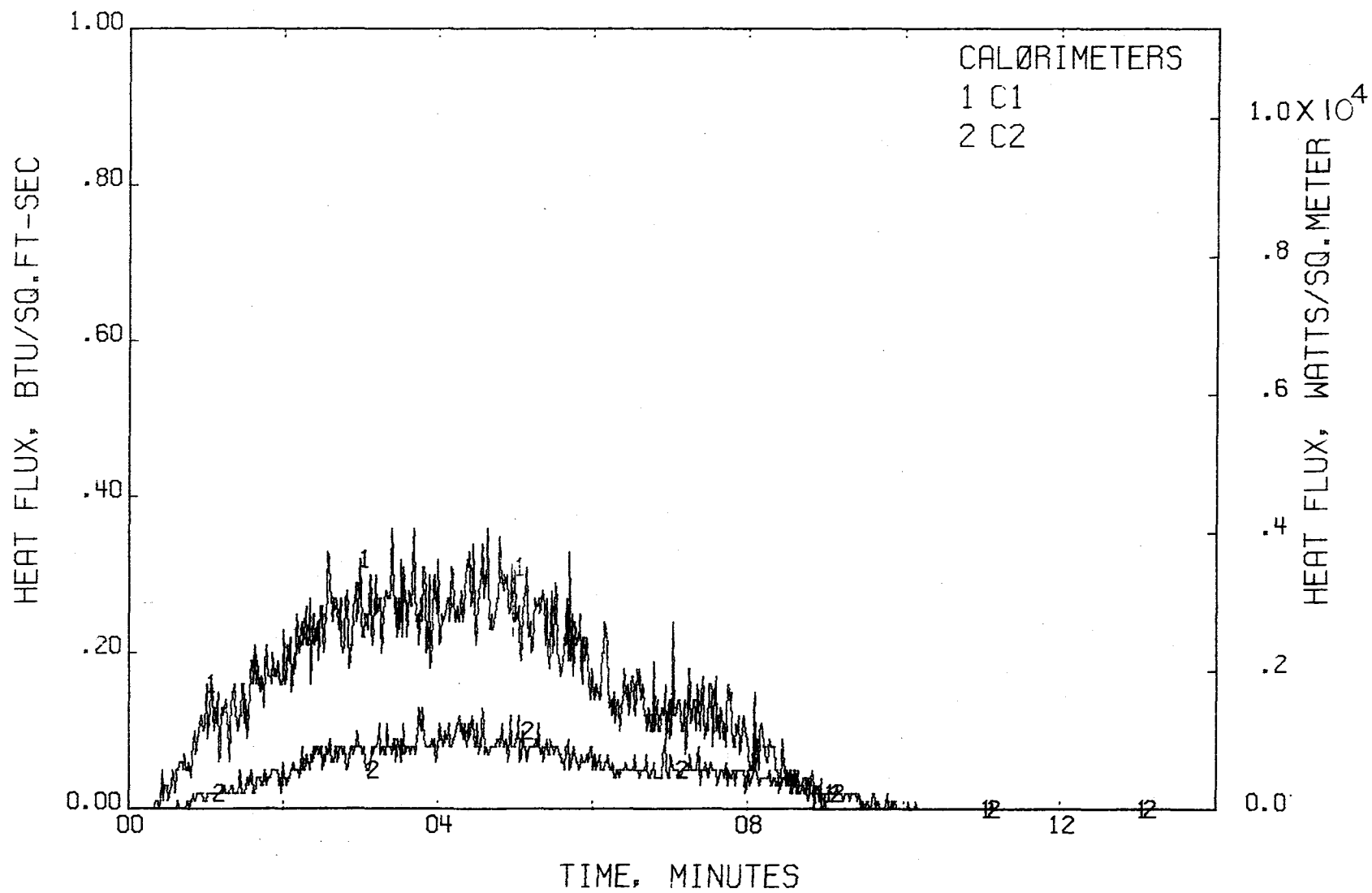


FIGURE 72 . - HEAT FLUX, AFT  
TEST 3

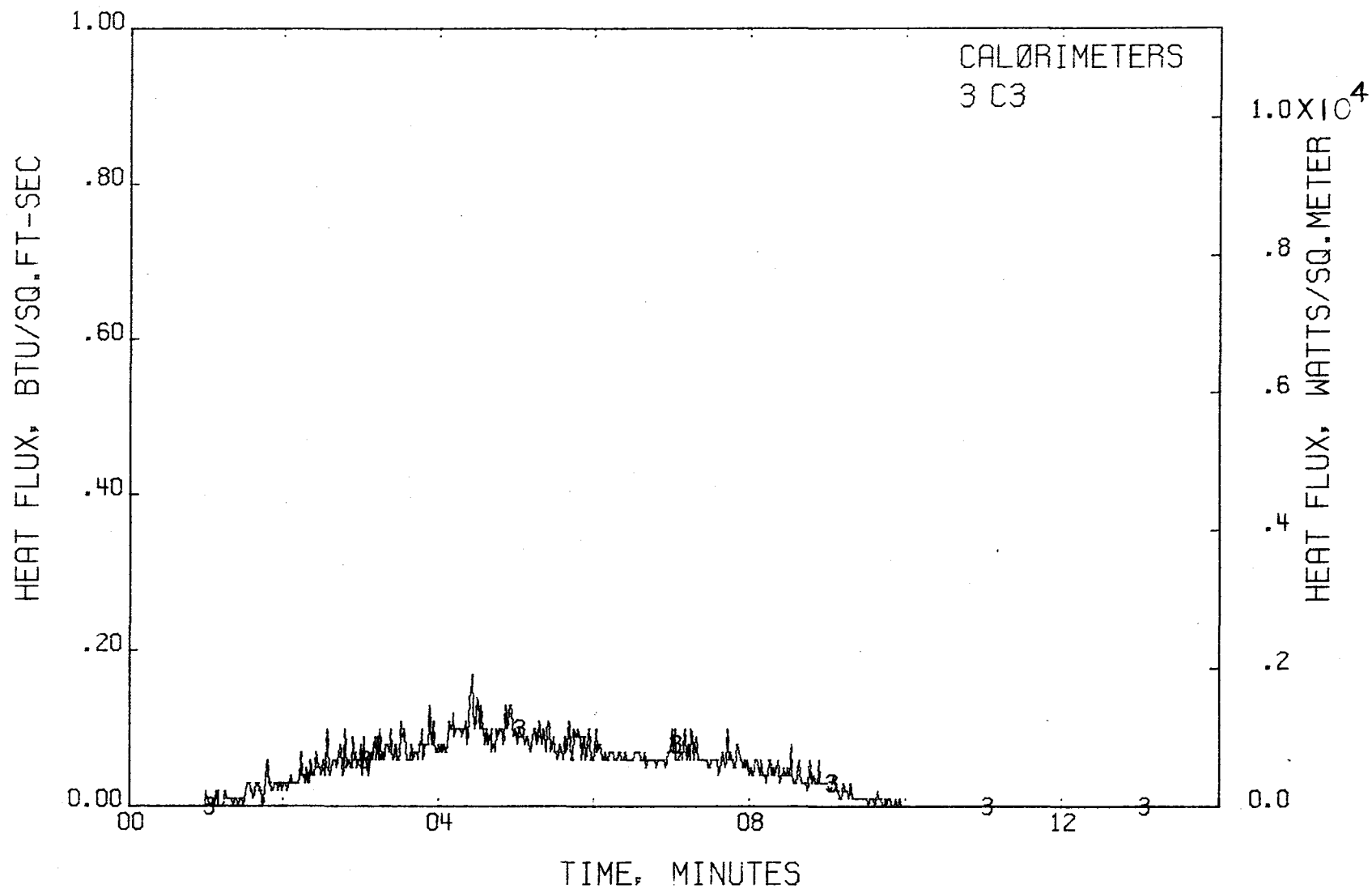


FIGURE 72 . - HEAT FLUX, AFT - CØNTINUED  
TEST 3

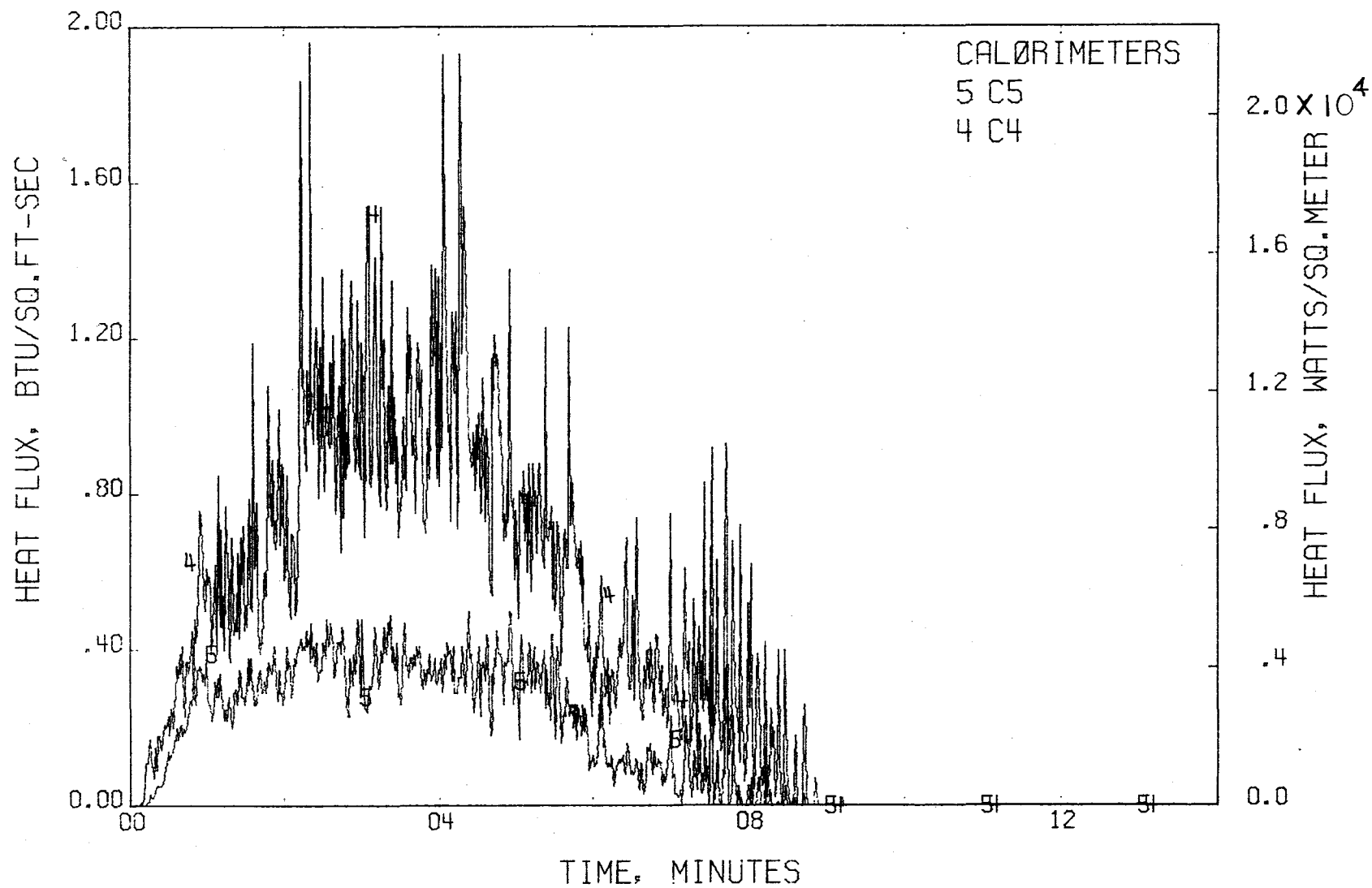


FIGURE 73 . - HEAT FLUX, MIDSECTION  
TEST 3

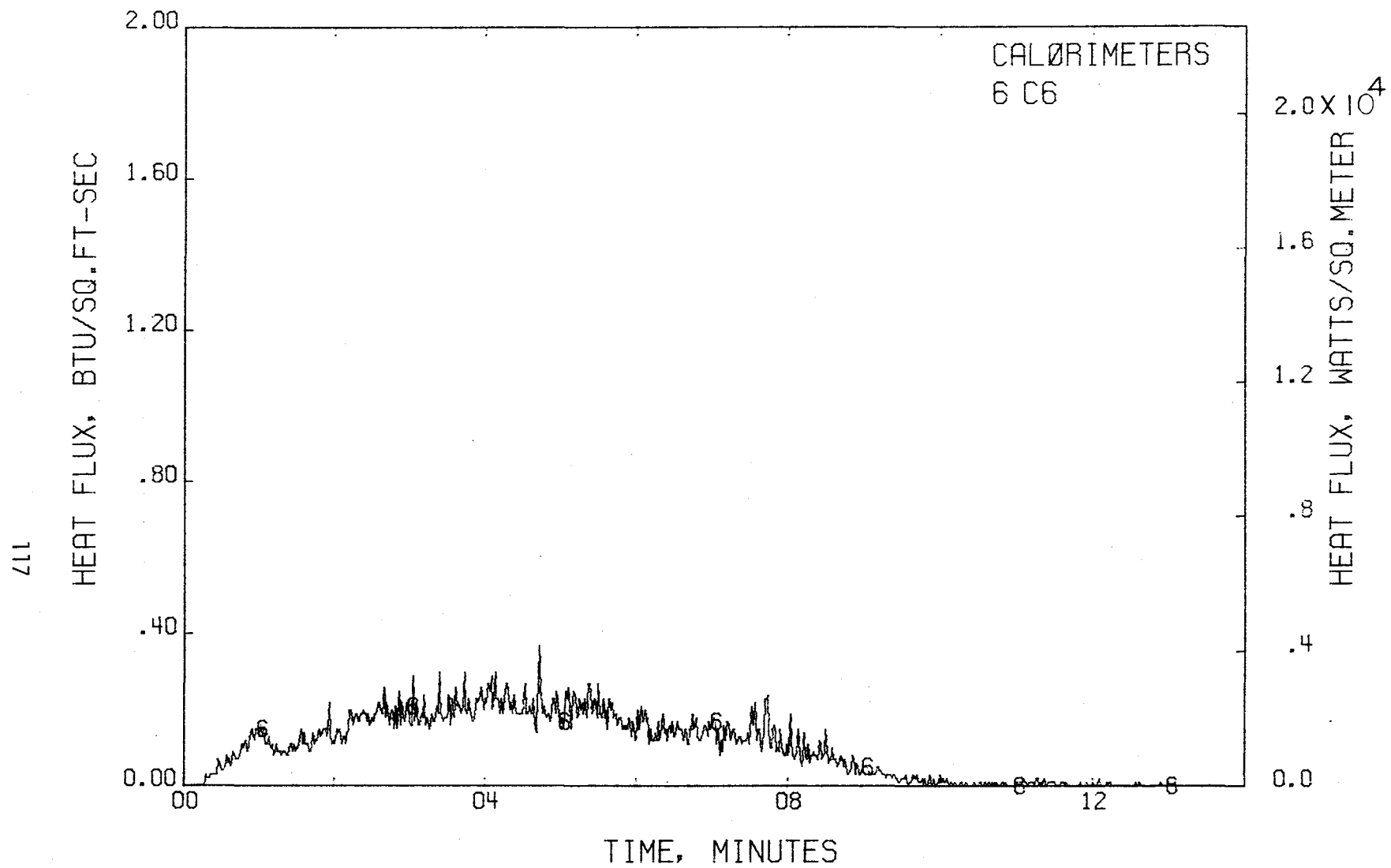
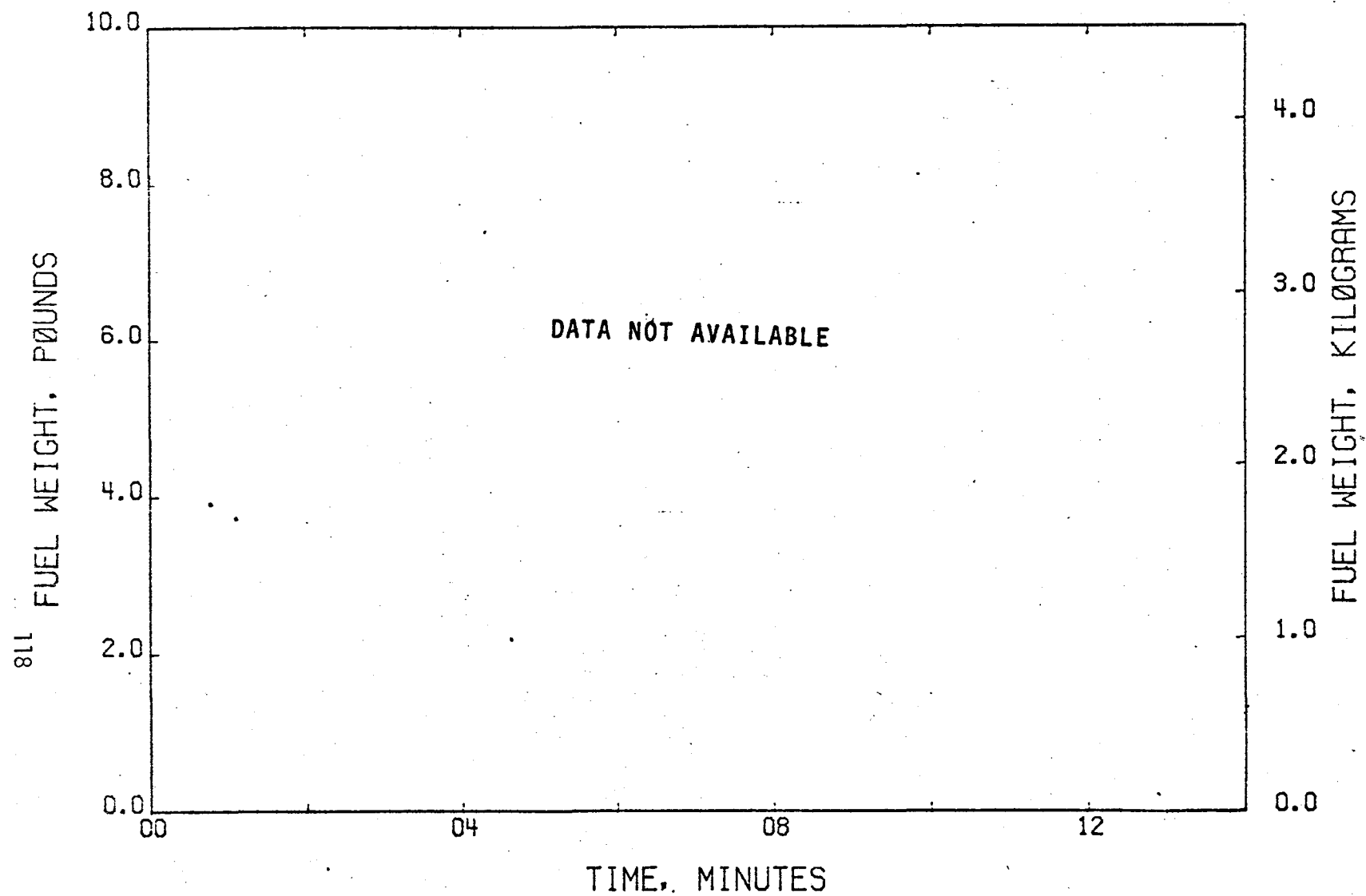


FIGURE 73 . - HEAT FLUX, MIDSECTION - CØNTINUED  
TEST 3



FUEL WEIGHT LOSS  
TEST 3

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM  
HYDROGEN FLUORIDE - <12 PPM  
HYDROGEN CHLORIDE - <24 PPM

FIGURE 74 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 3

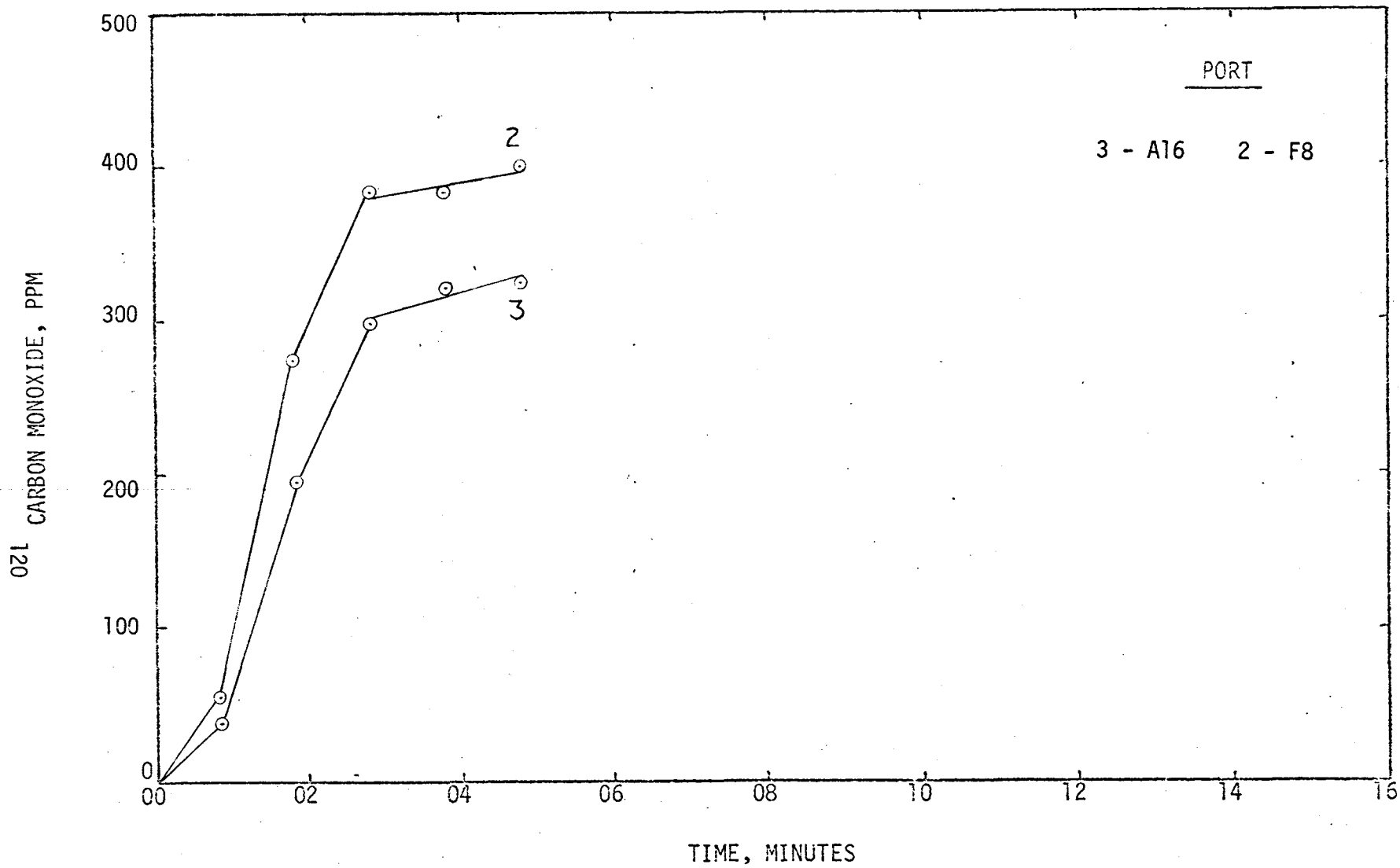


FIGURE 75 CARBON MONOXIDE CONCENTRATIONS  
TEST 3



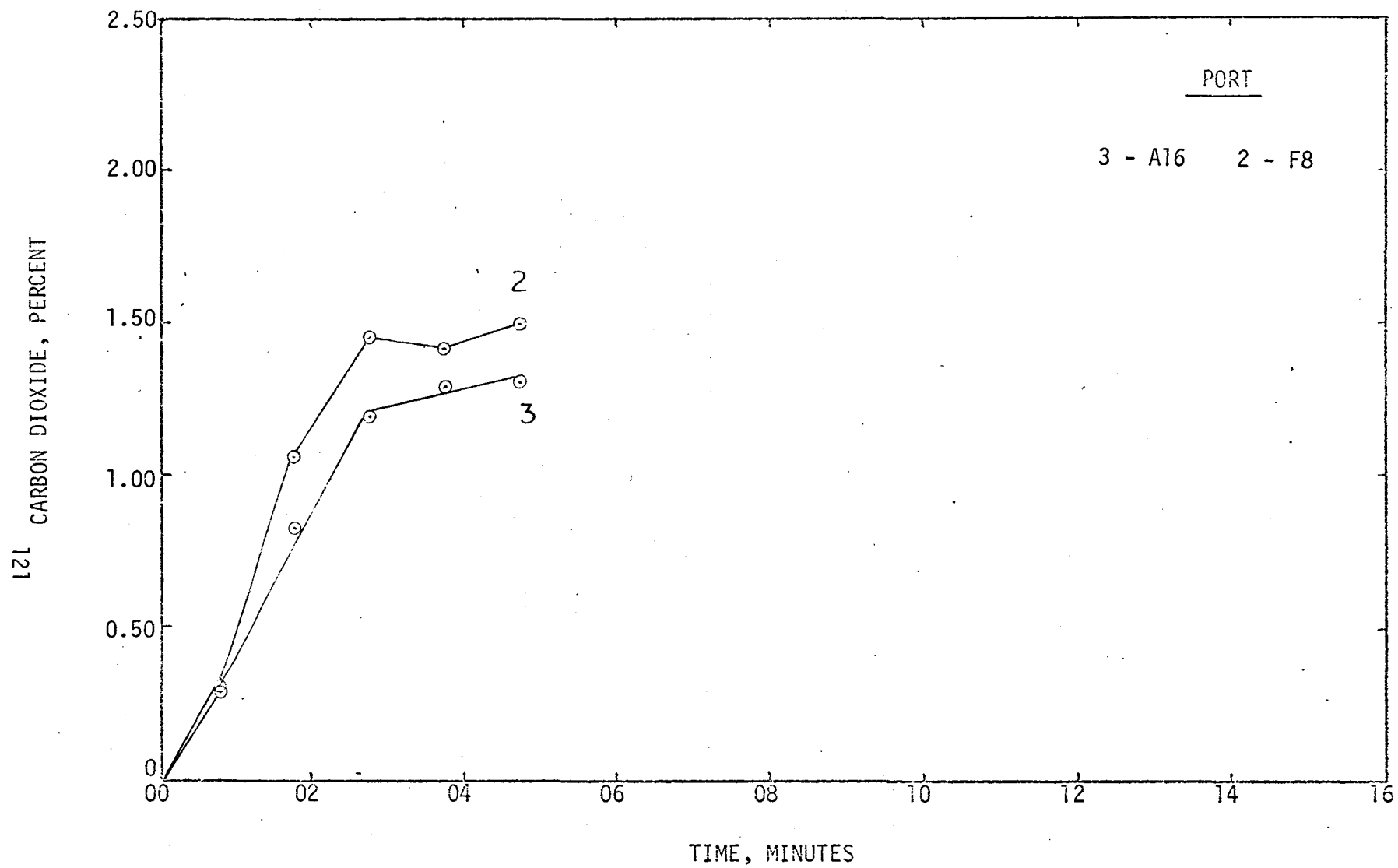


FIGURE 76 . - CARBON DIOXIDE CONCENTRATIONS  
TEST 3

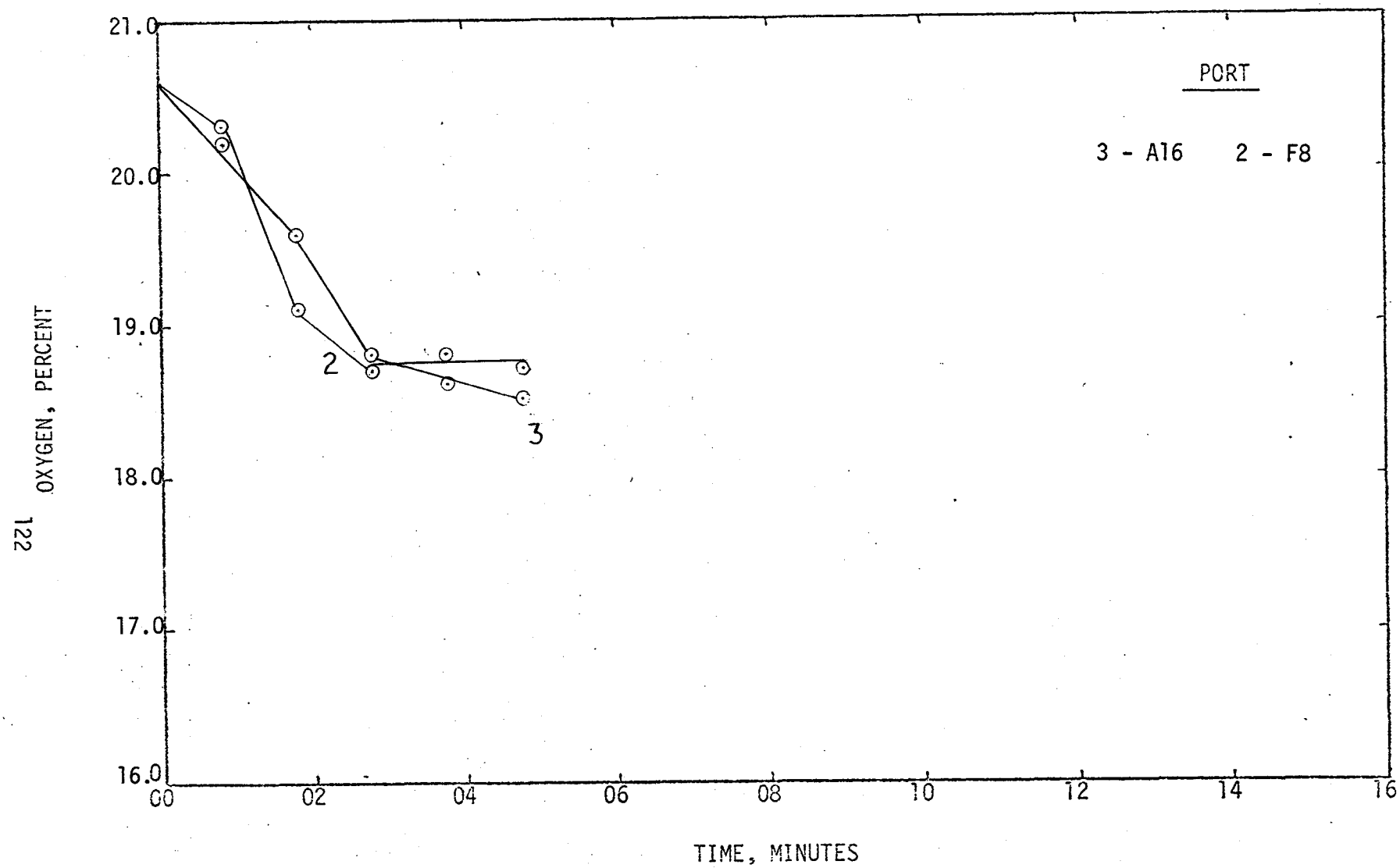


FIGURE 77 , - OXYGEN CONCENTRATIONS

TEST 3

TEST 4  

---

FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 4

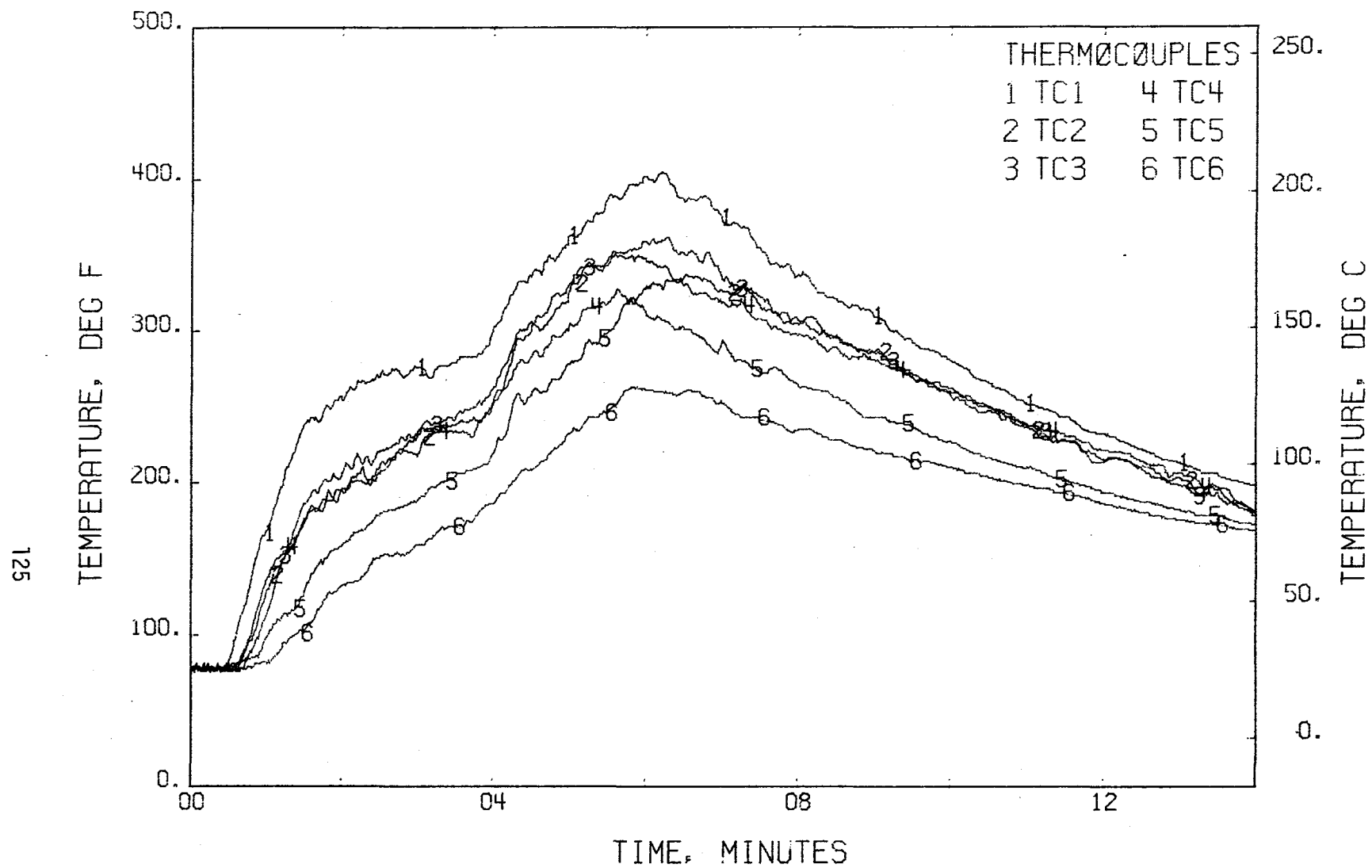


FIGURE 78 . - TEMPERATURES, T/C TREE 1  
TEST 4

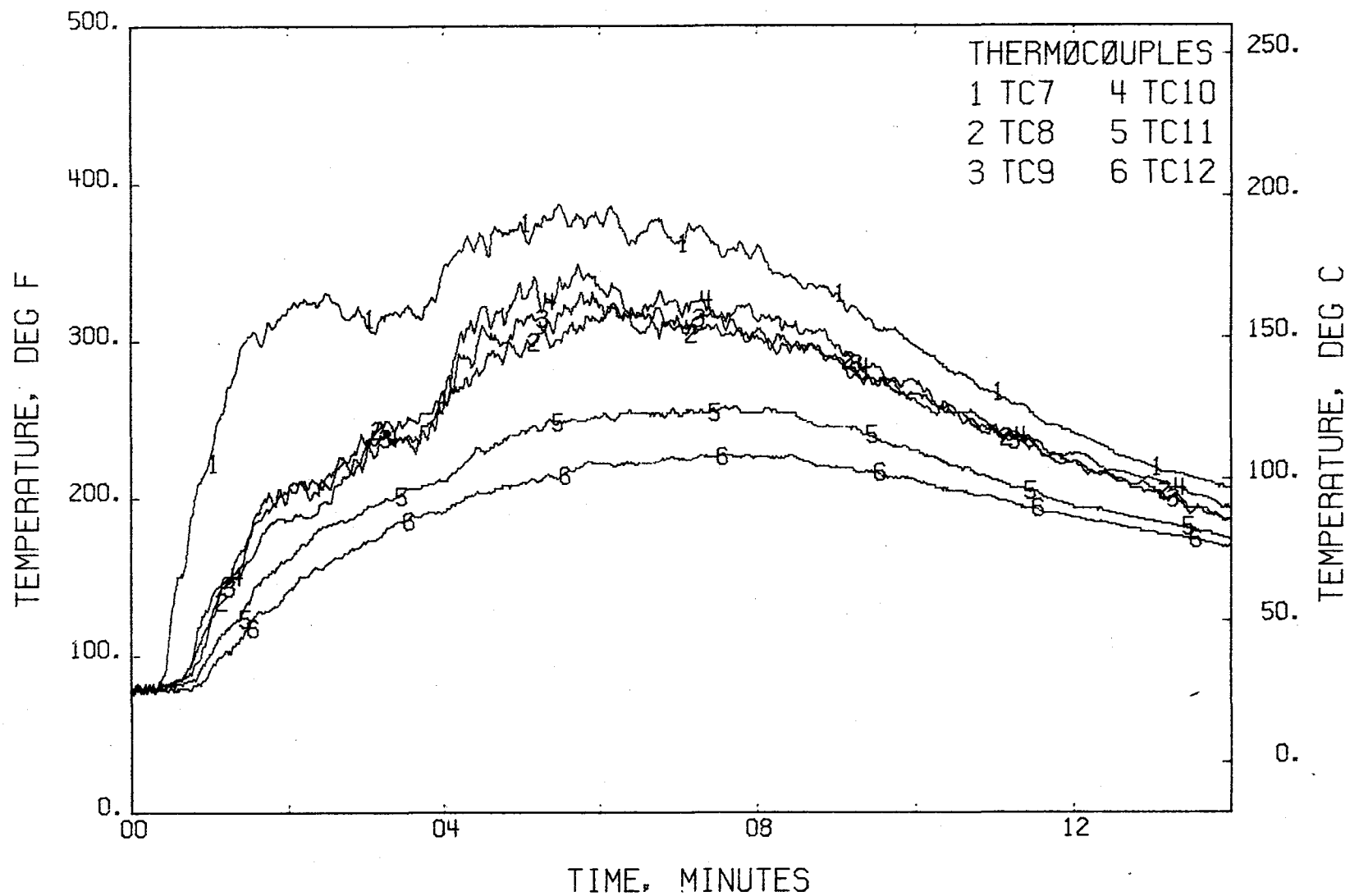


FIGURE 79 . - TEMPERATURES, T/C TREE 2  
TEST 4

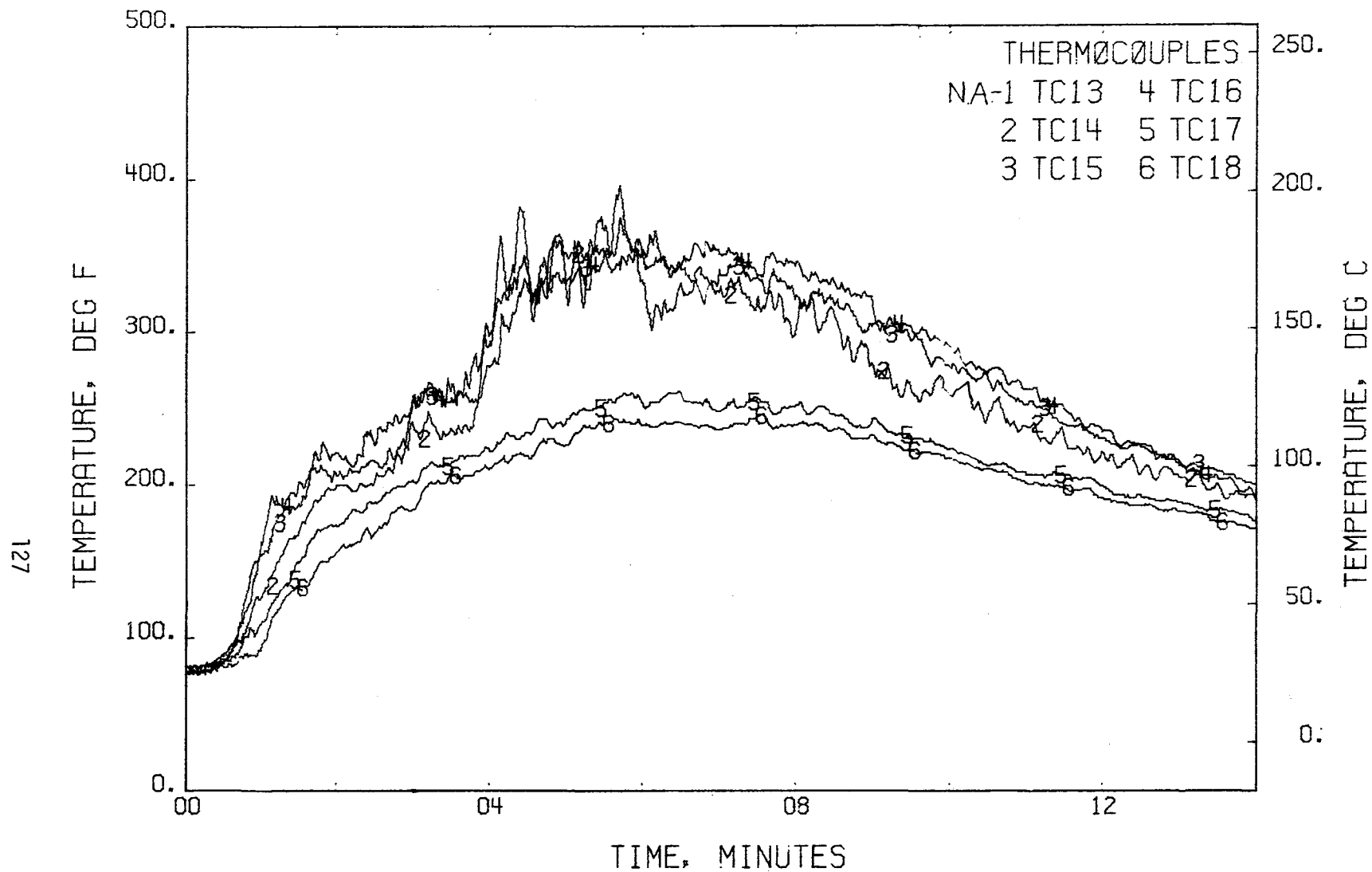


FIGURE 80 . - TEMPERATURES, T/C TREE 3  
TEST 4

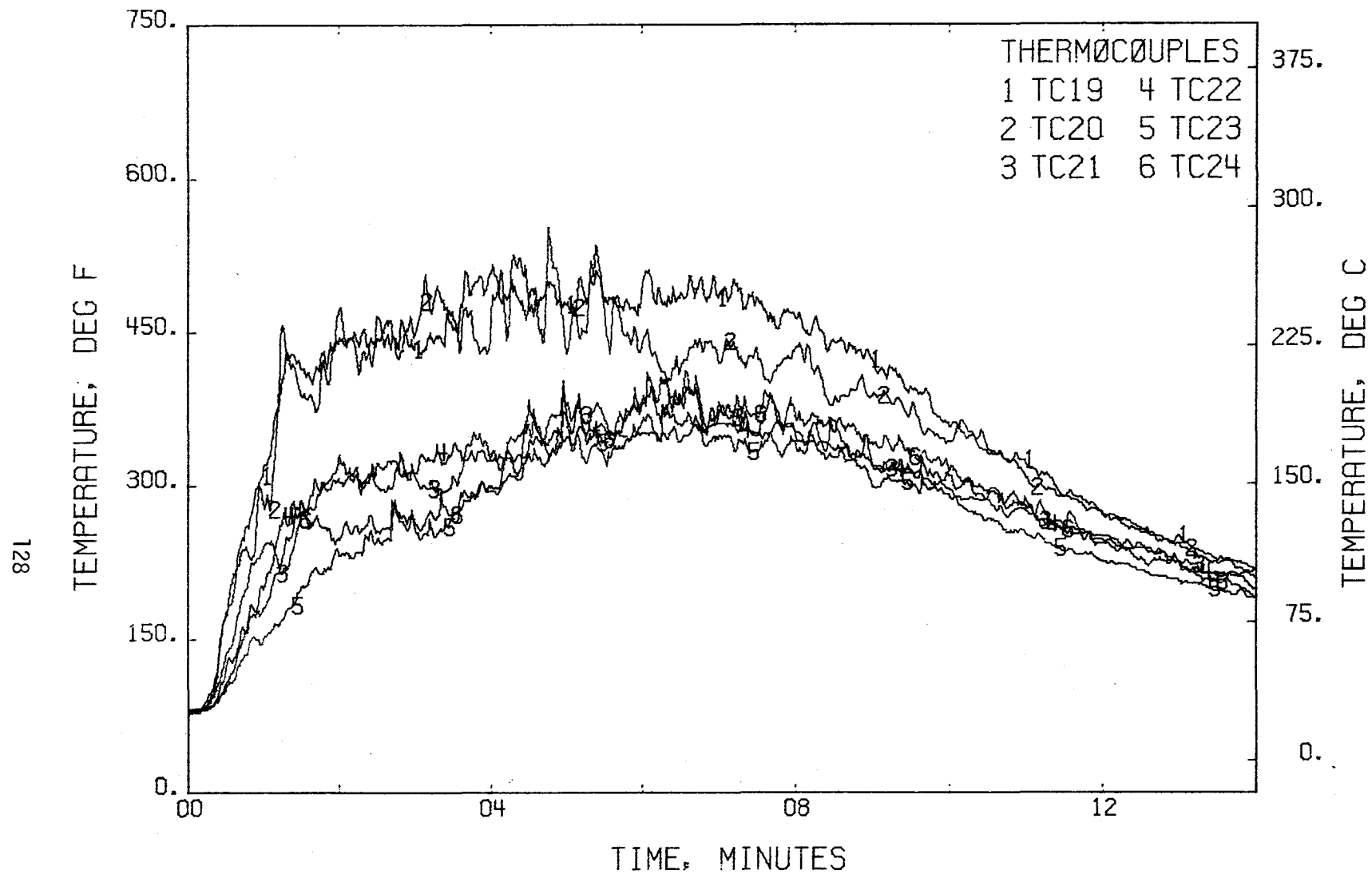


FIGURE 81 . - TEMPERATURES, T/C TREE 4  
TEST 4



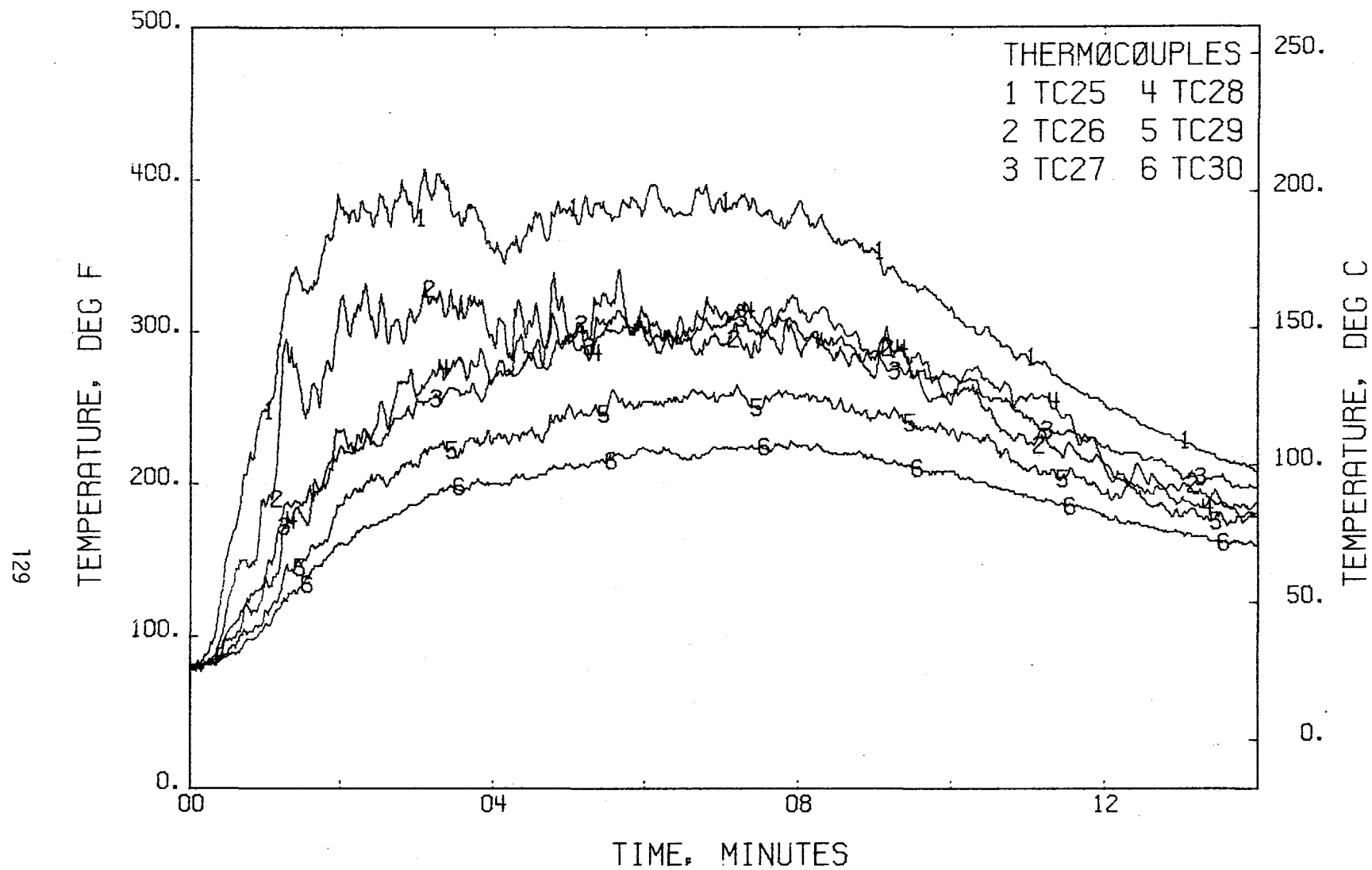


FIGURE 82 . - TEMPERATURES, T/C TREE 5  
TEST 4

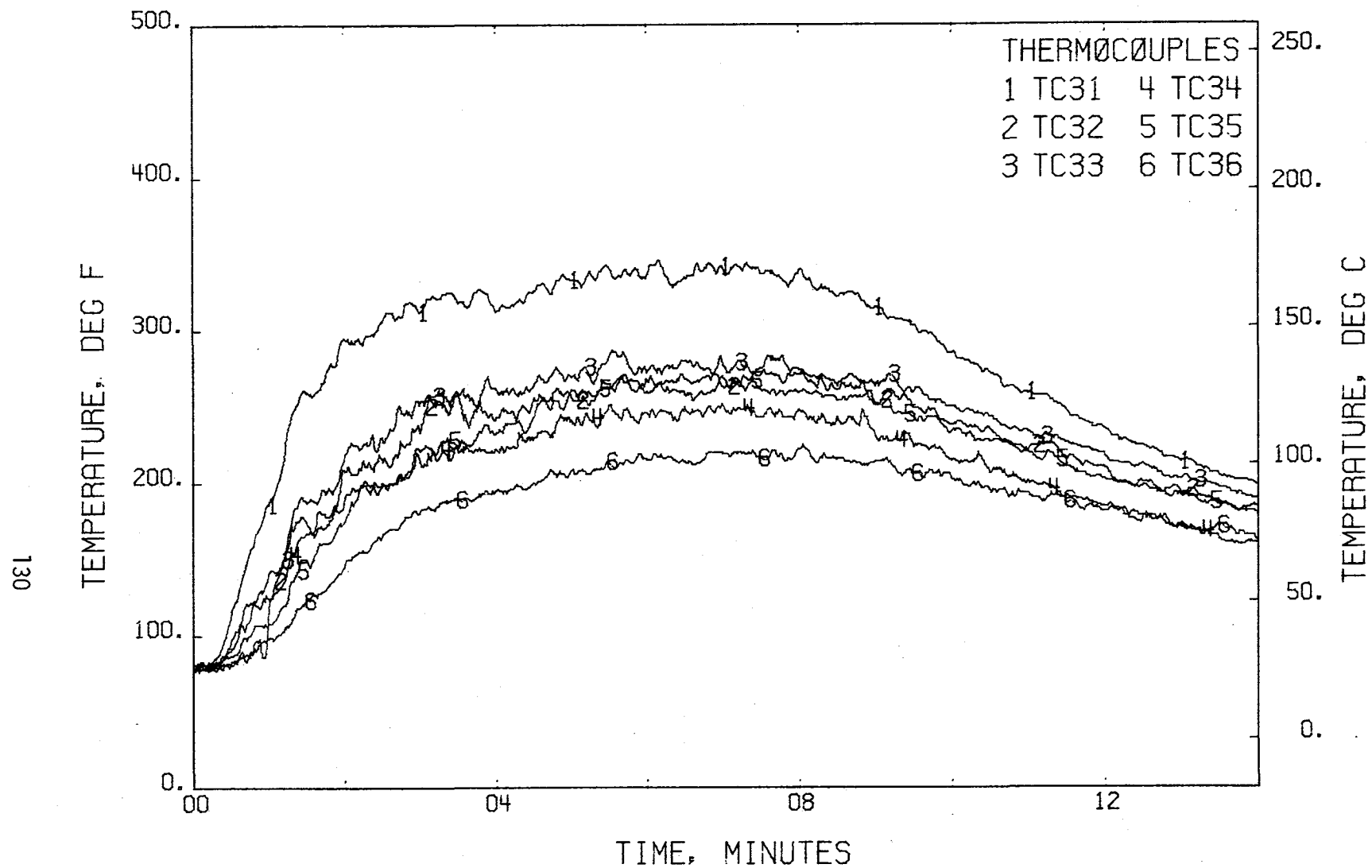


FIGURE 83 . - TEMPERATURES, T/C TREE 6  
TEST 4

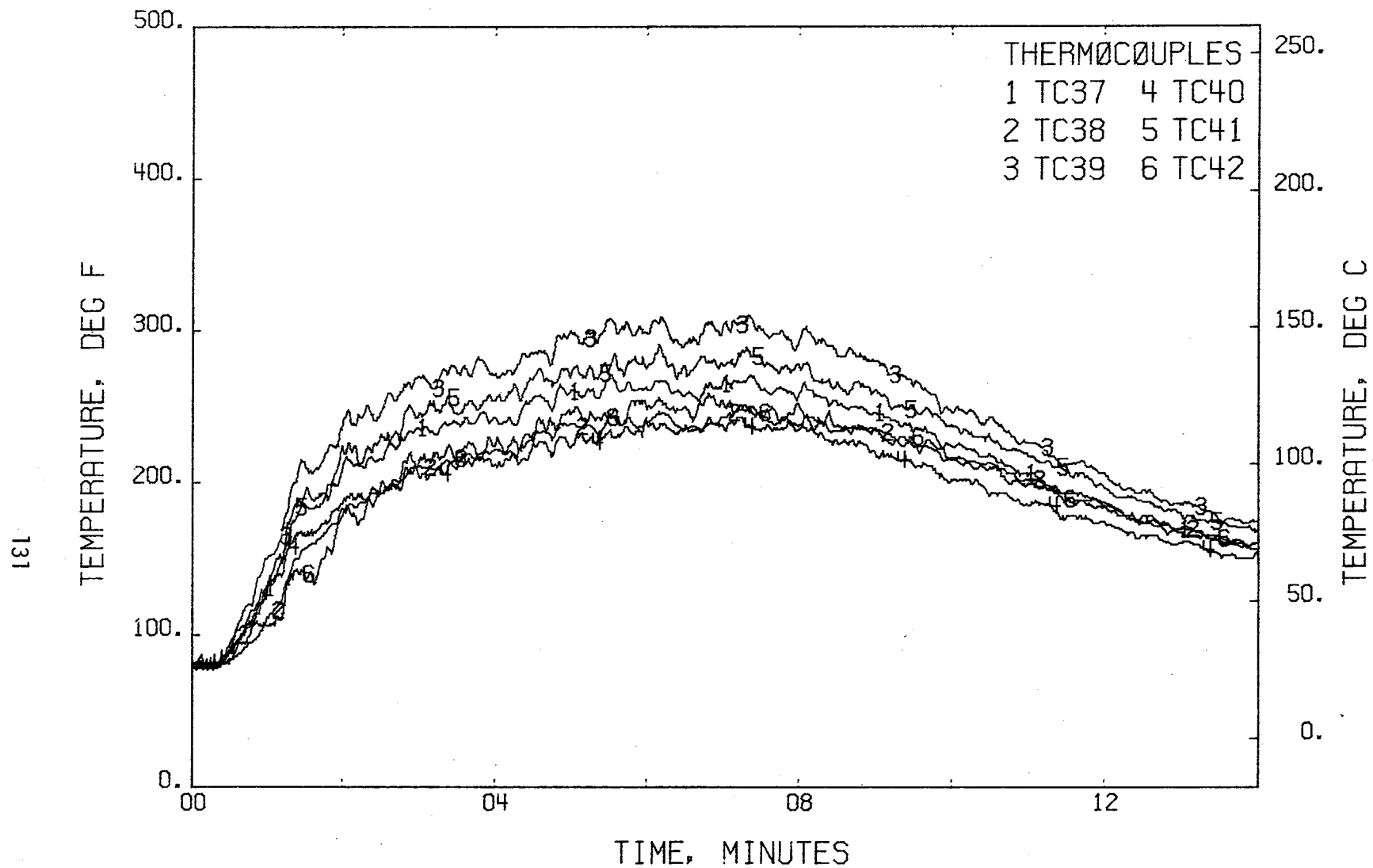


FIGURE 84 . - TEMPERATURES, T/C TREE 7  
TEST 4

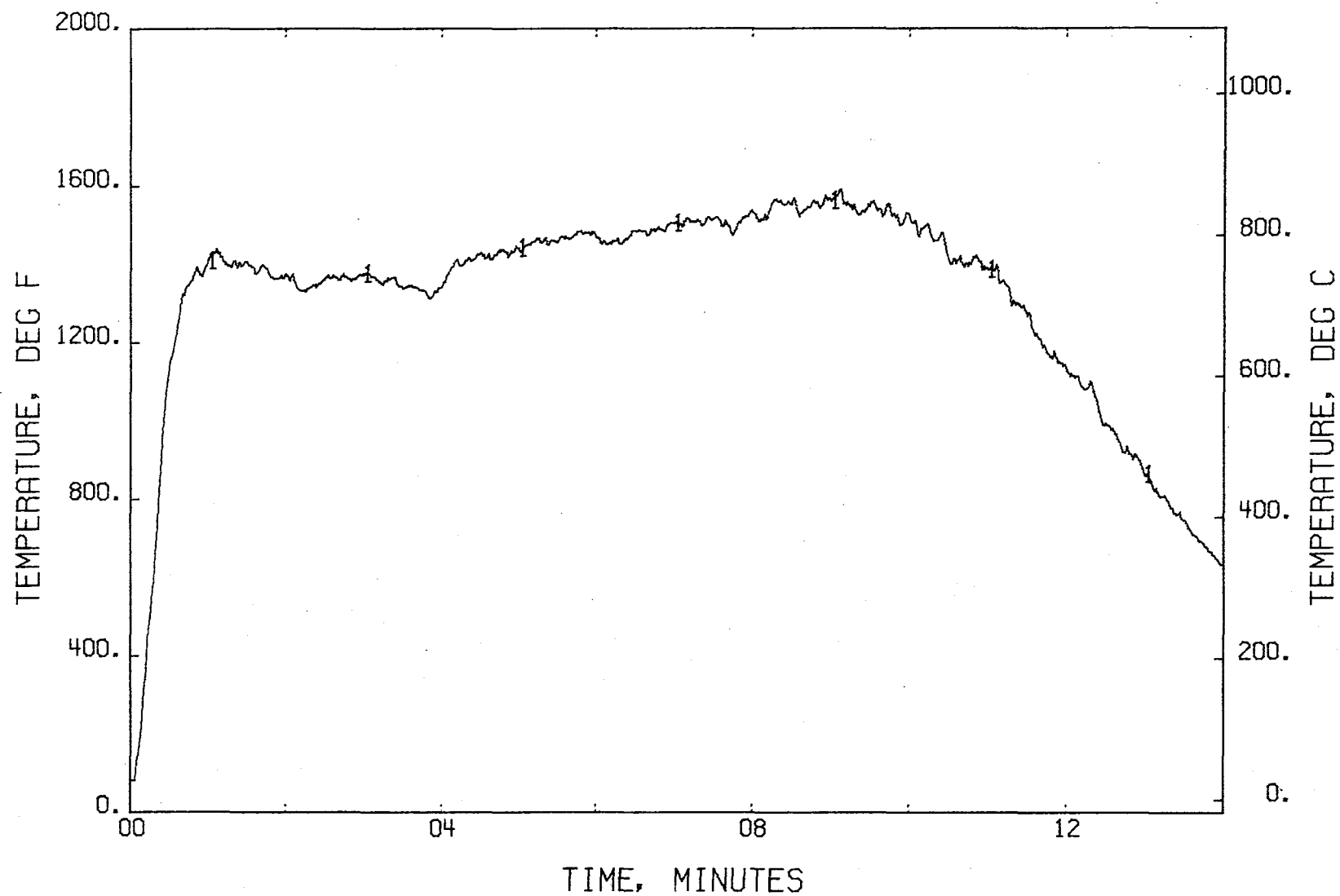


FIGURE 85 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 4

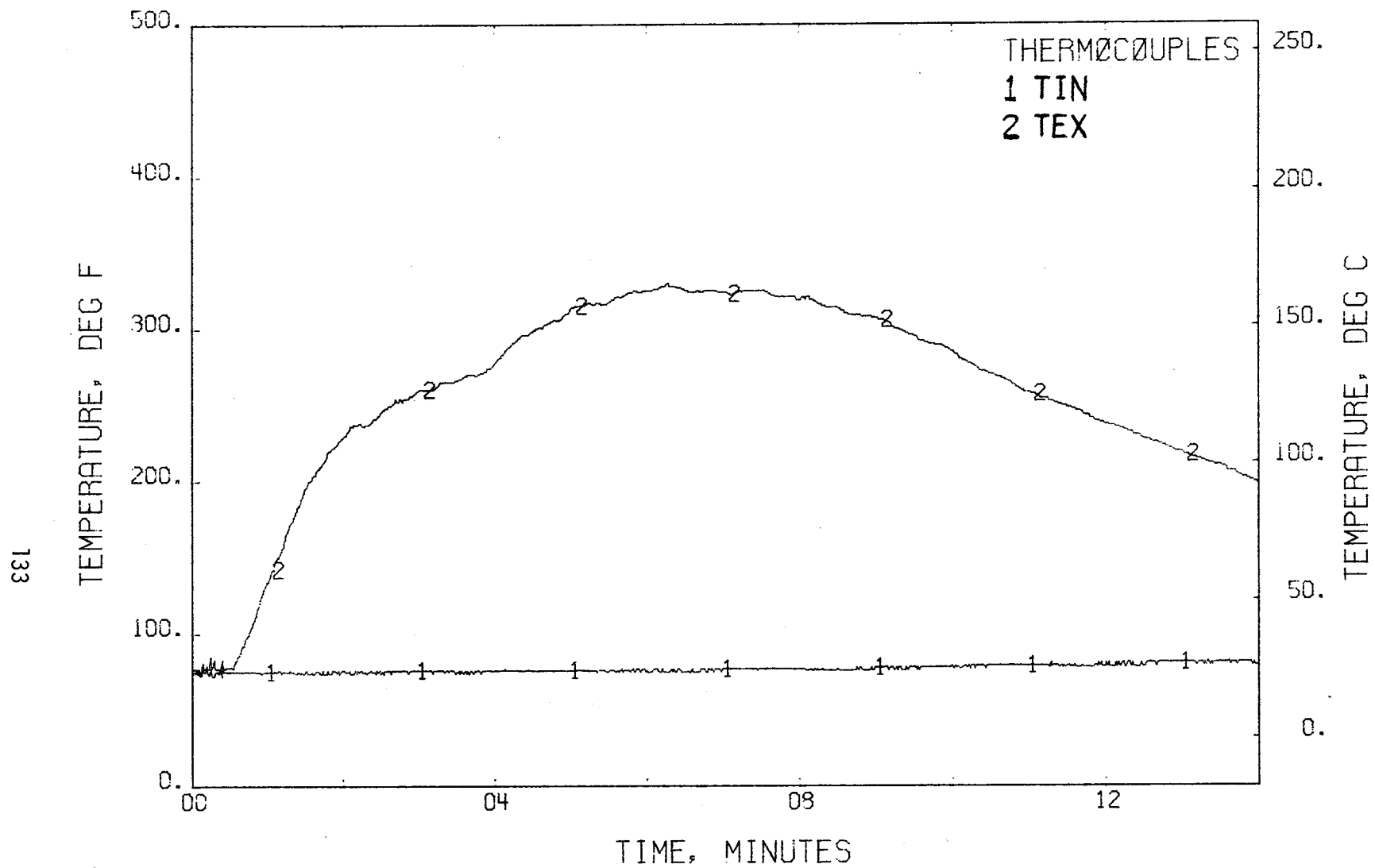


FIGURE 86 . - TEMPERATURES, INLET + EXIT  
TEST 4

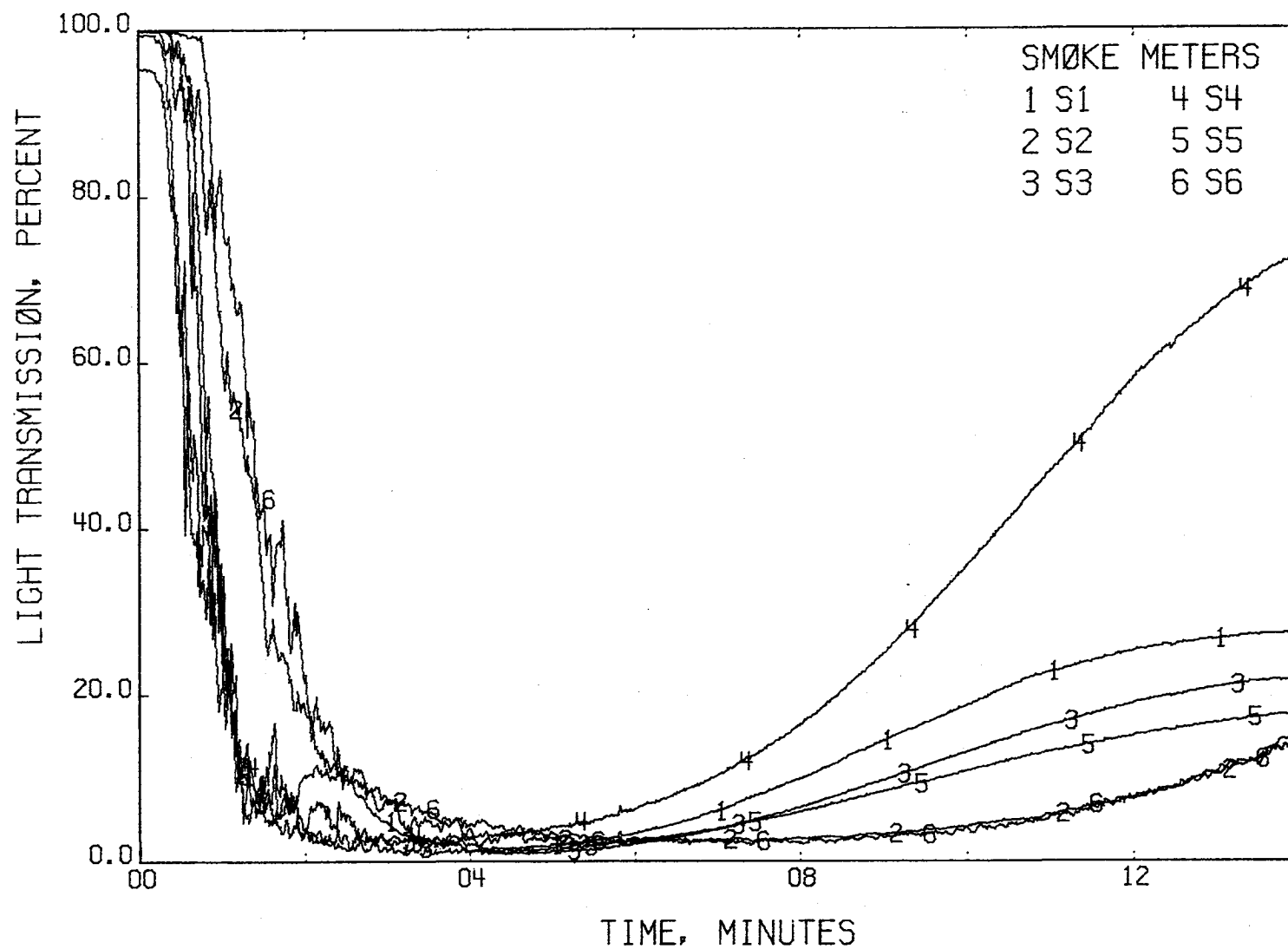


FIGURE 87 . - LIGHT TRANSMISSION  
TEST 4

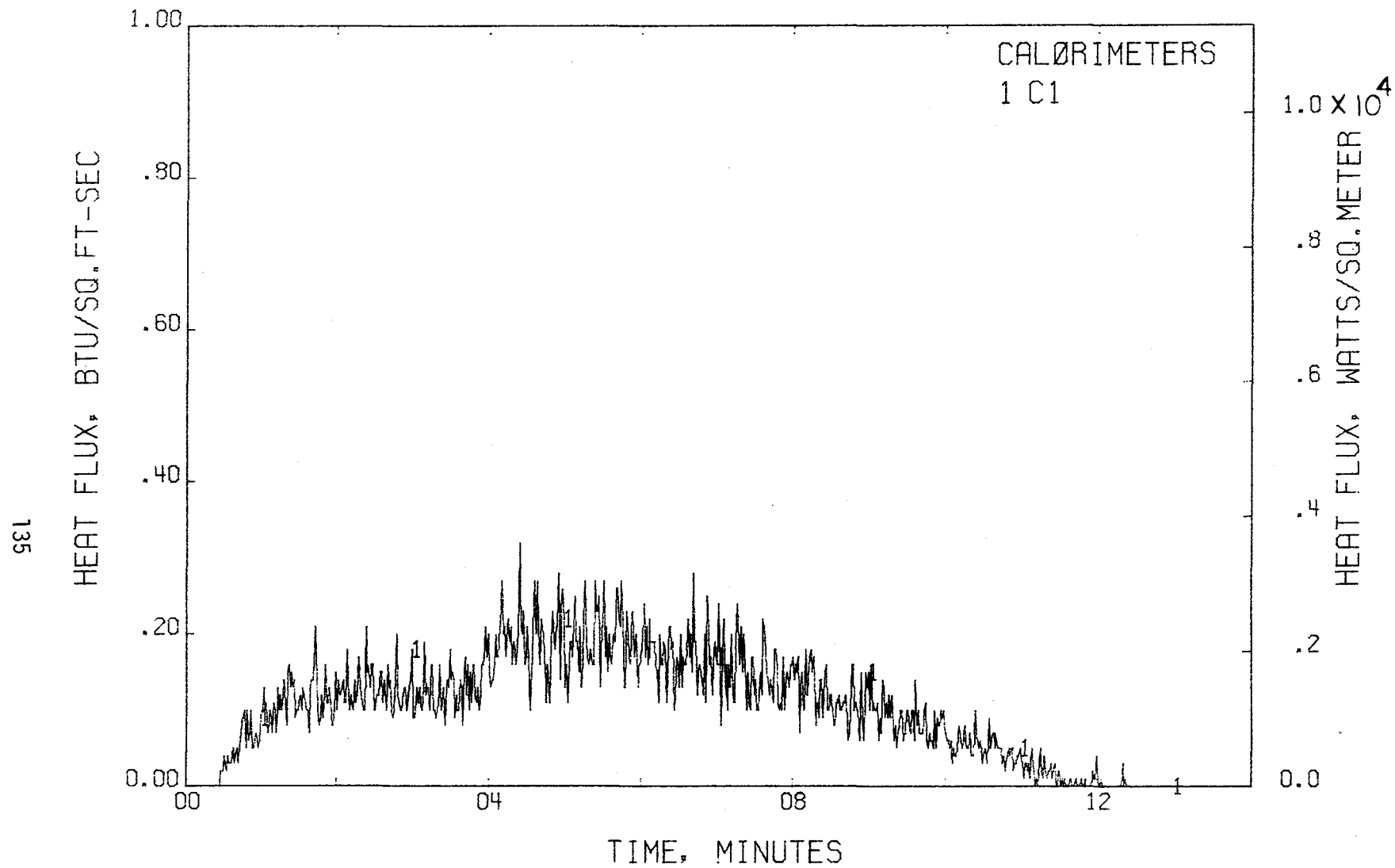


FIGURE 88 . - HEAT FLUX, AFT  
TEST 4

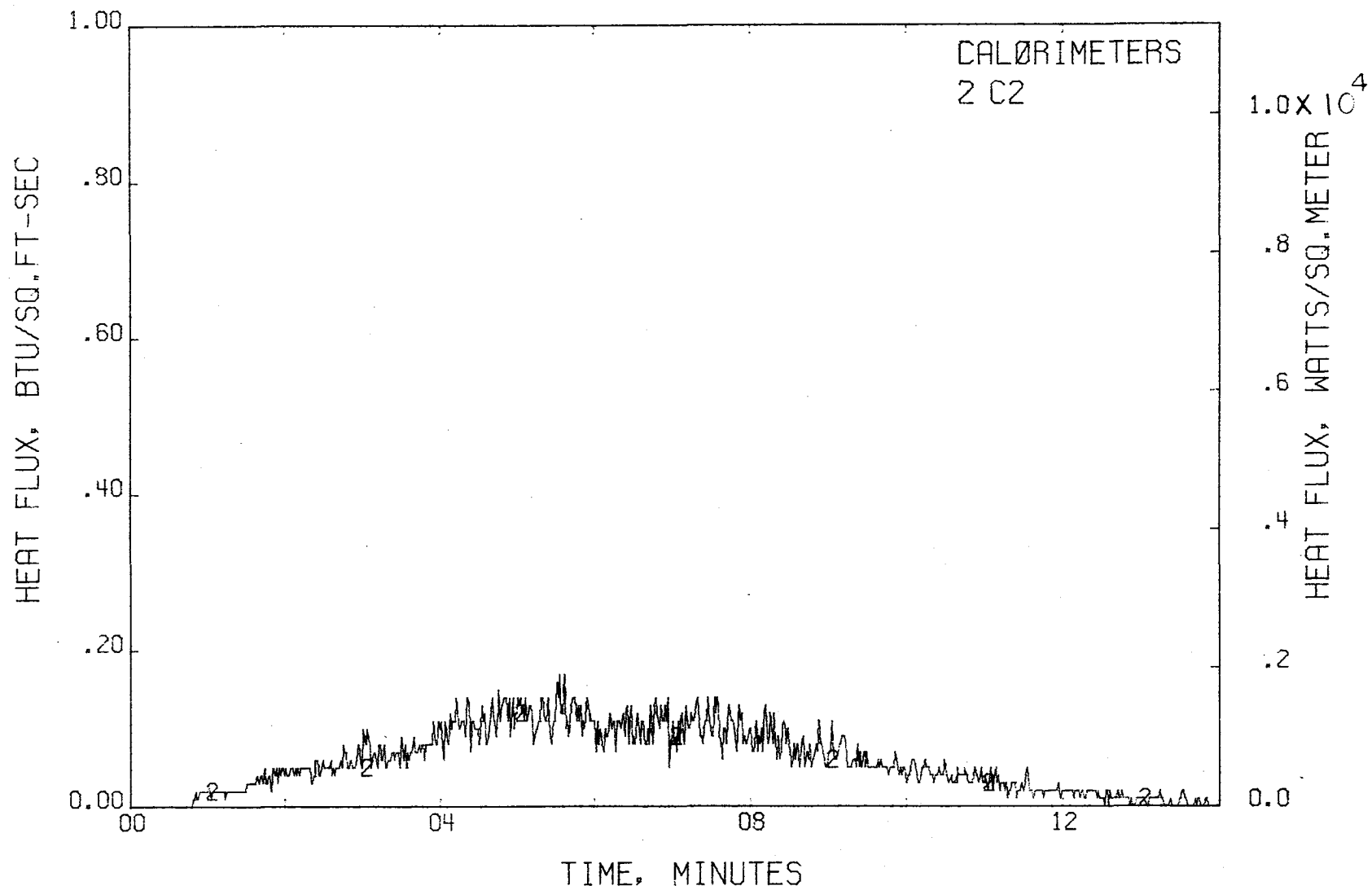


FIGURE 88 . - HEAT FLUX, AFT - CØNTINUED  
TEST 4



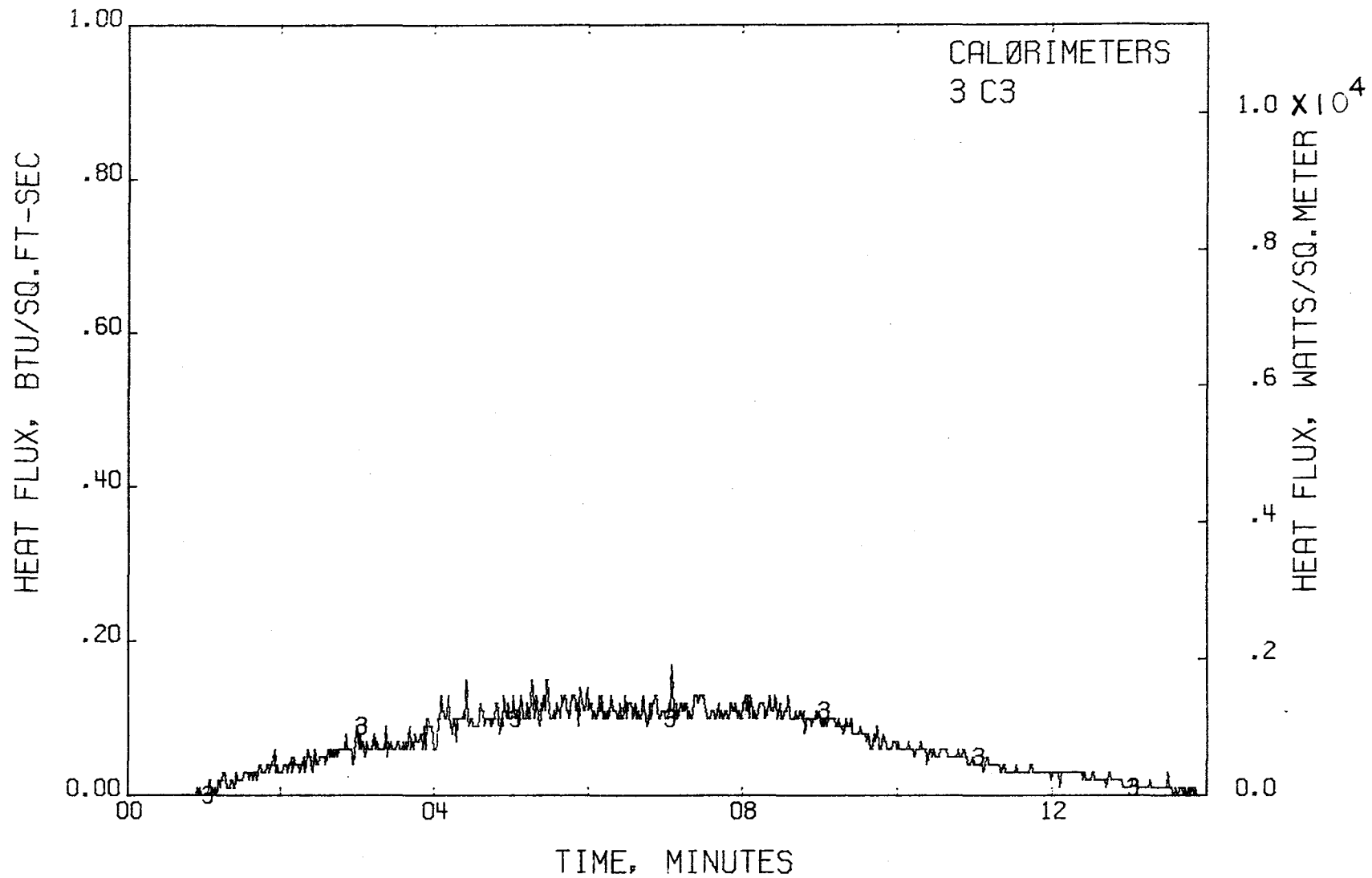


FIGURE 88 . - HEAT FLUX, AFT - CONTINUED  
TEST 4

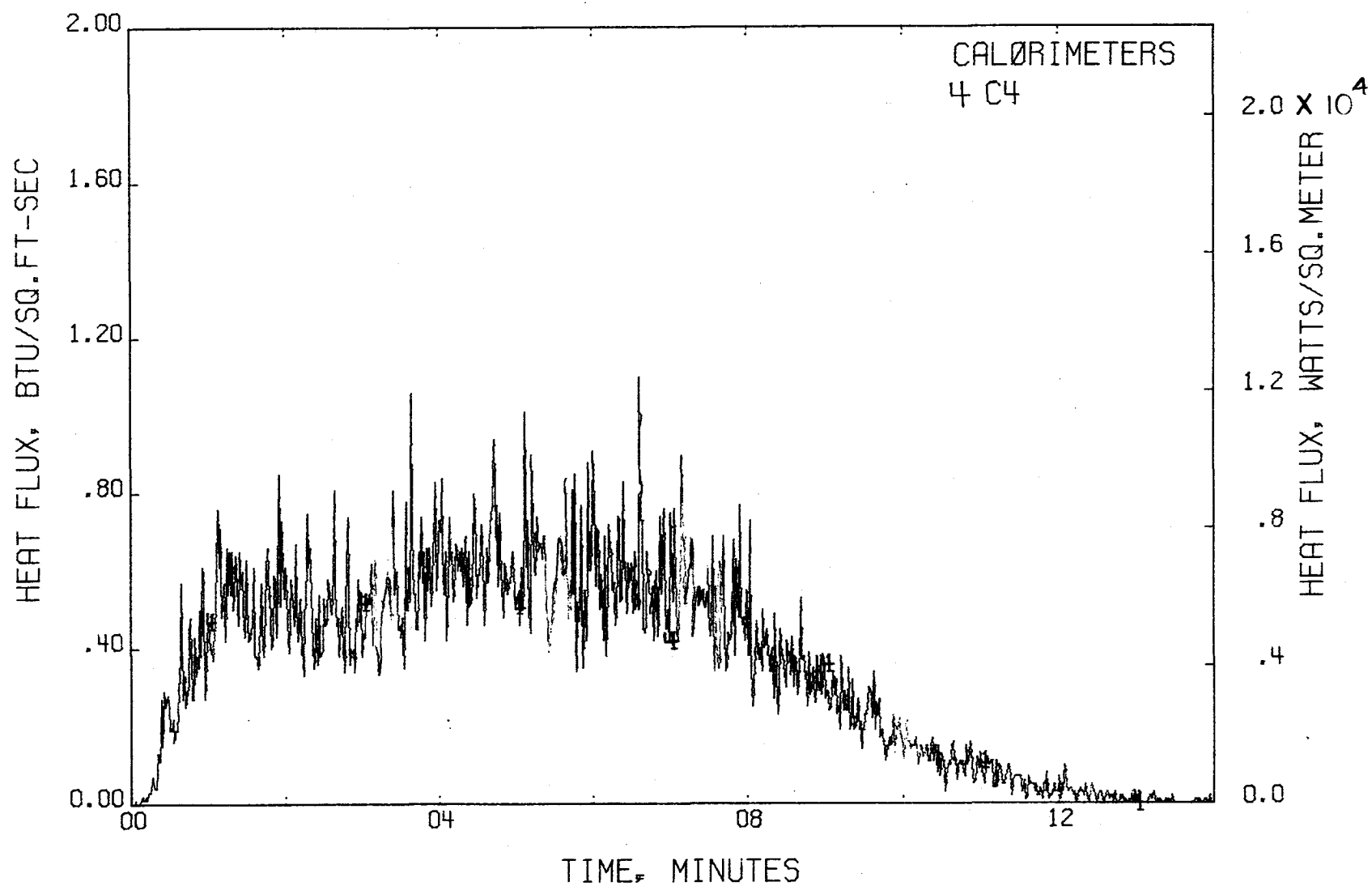


FIGURE 89 . - HEAT FLUX, MIDSECTION  
TEST 4

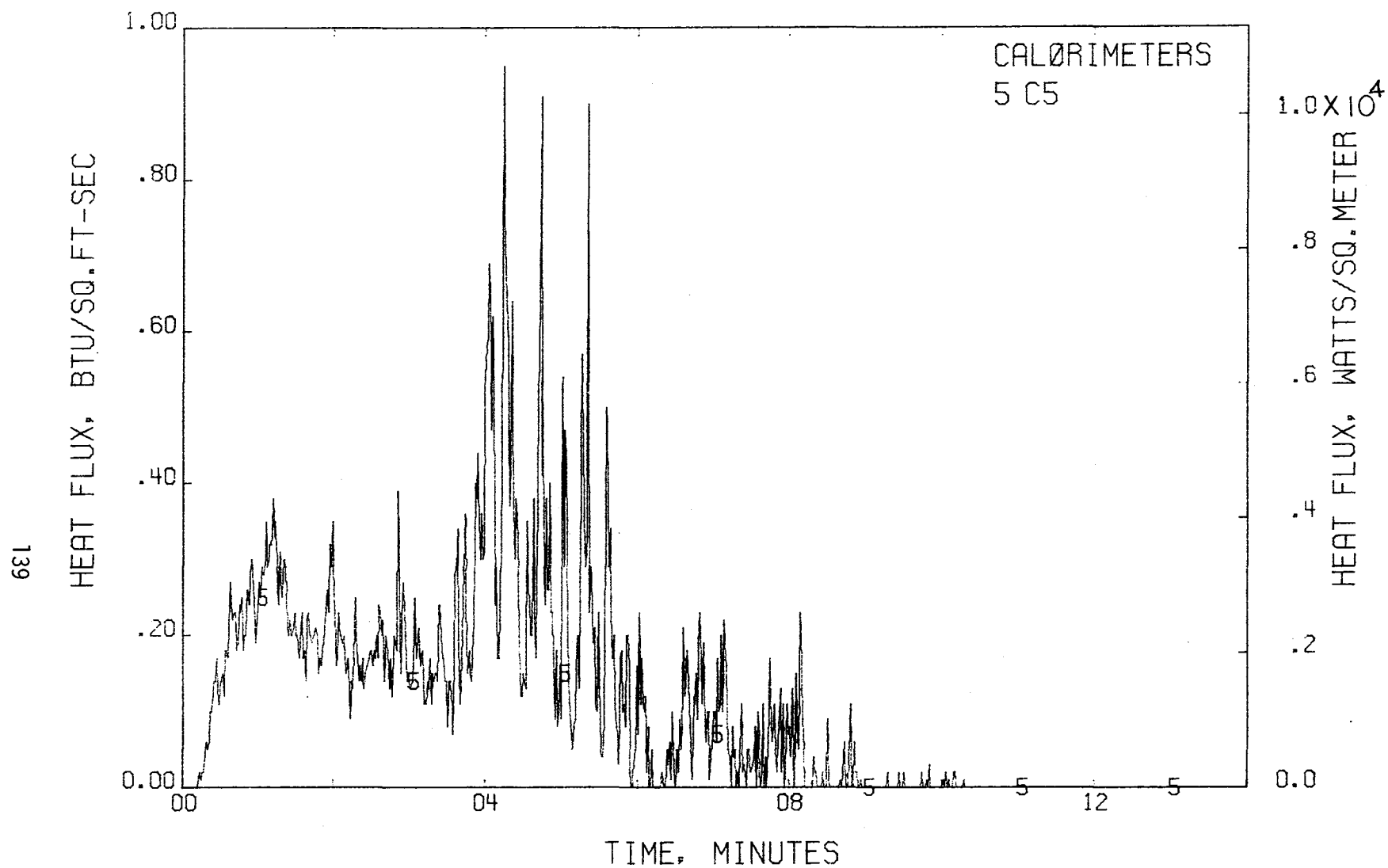


FIGURE 89 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 4

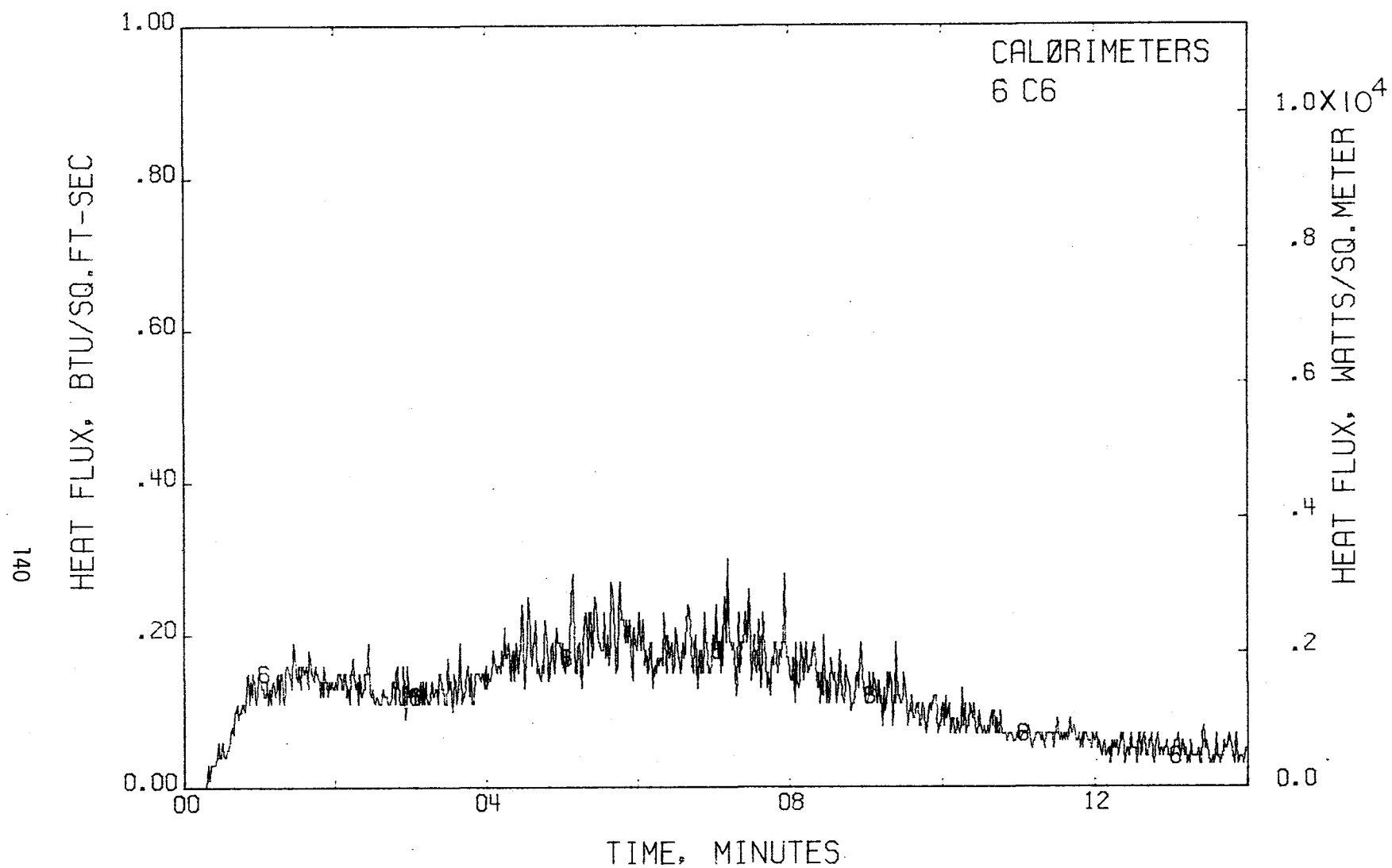


FIGURE 89 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 4

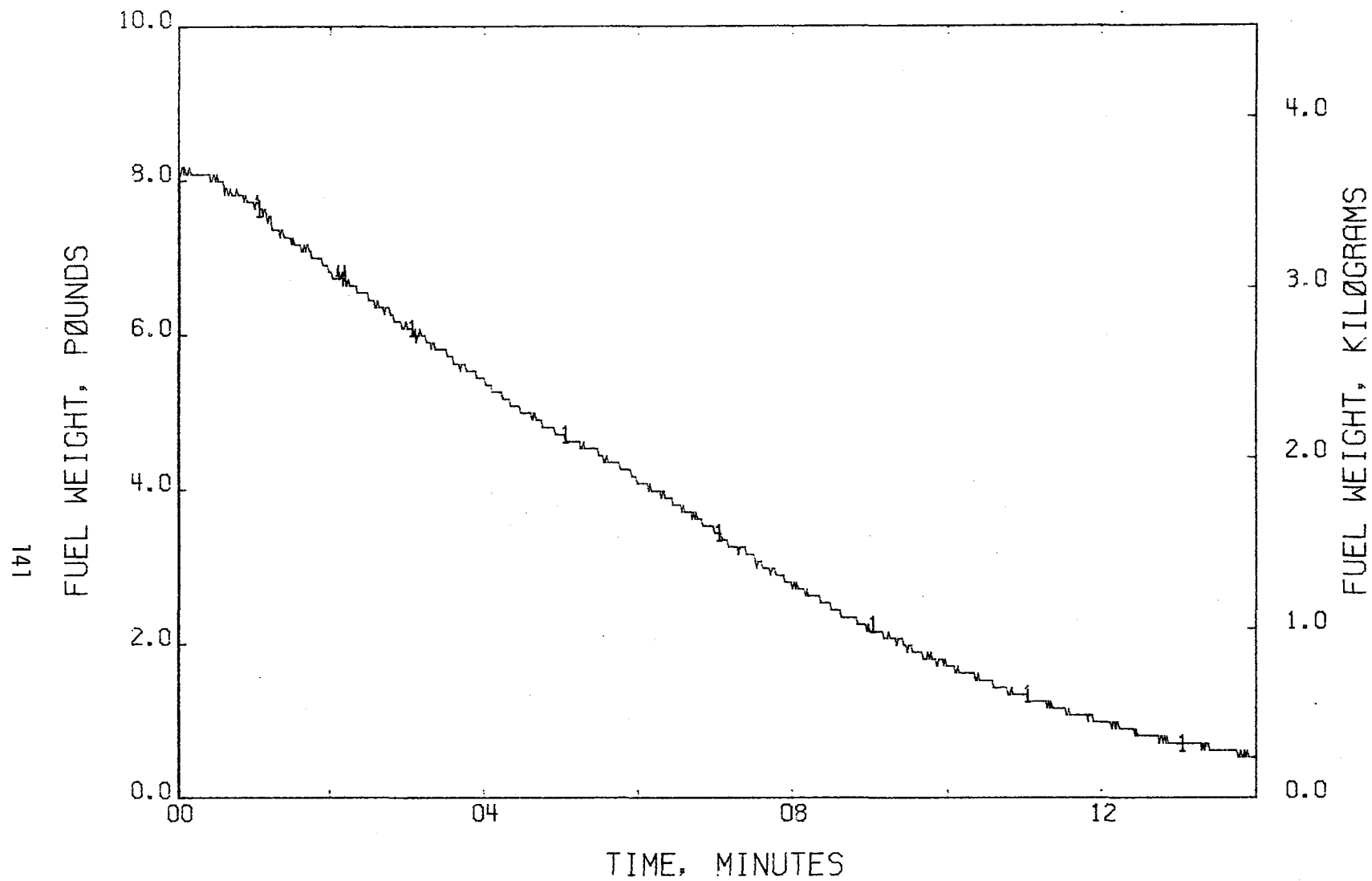


FIGURE 90 . - FUEL WEIGHT LOSS  
TEST 4

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM

HYDROGEN FLUORIDE - <12 PPM

HYDROGEN CHLORIDE - <24 PPM

FIGURE 91 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 4

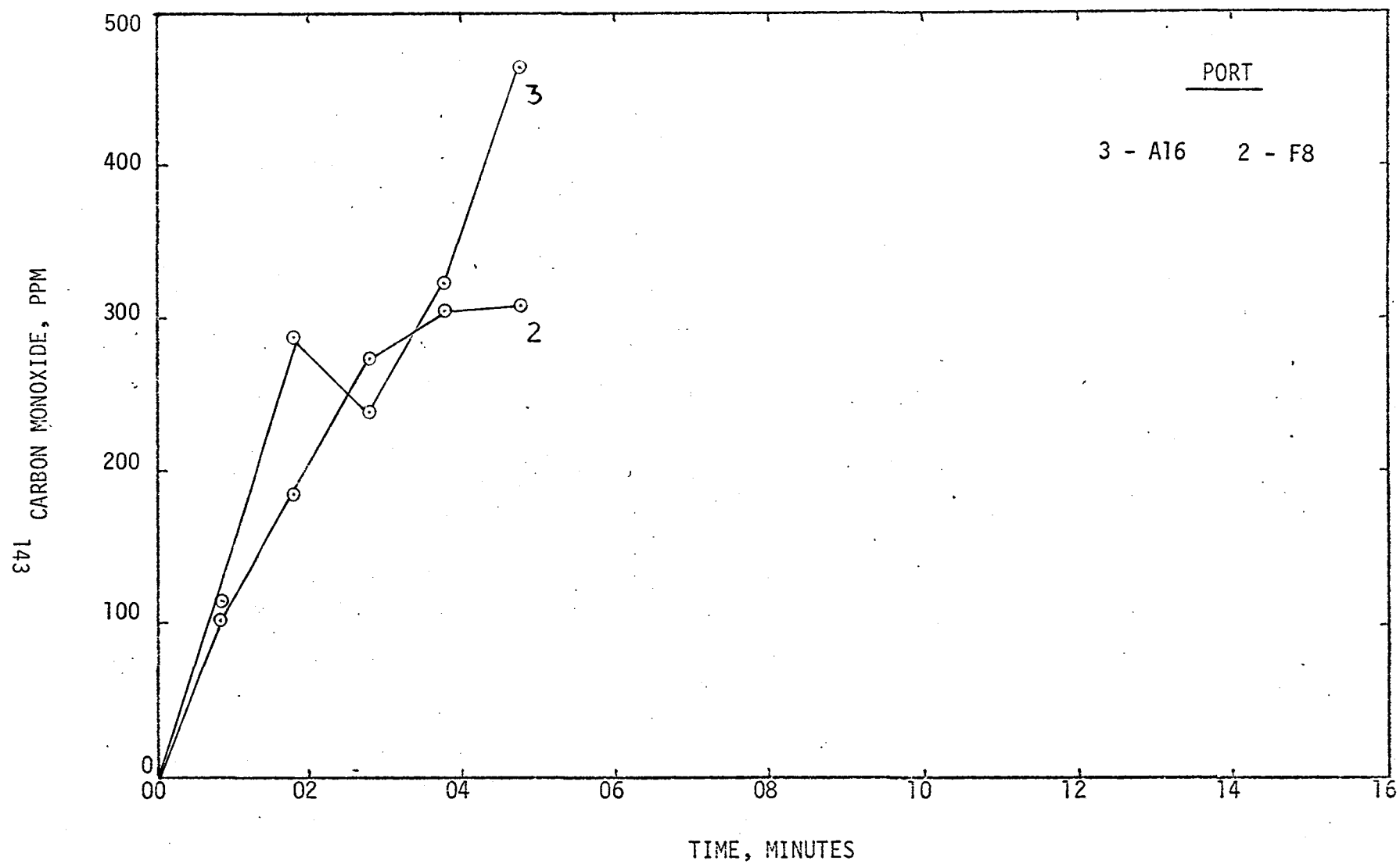


FIGURE 92 . - CARBON MONOXIDE CONCENTRATIONS  
TEST 4

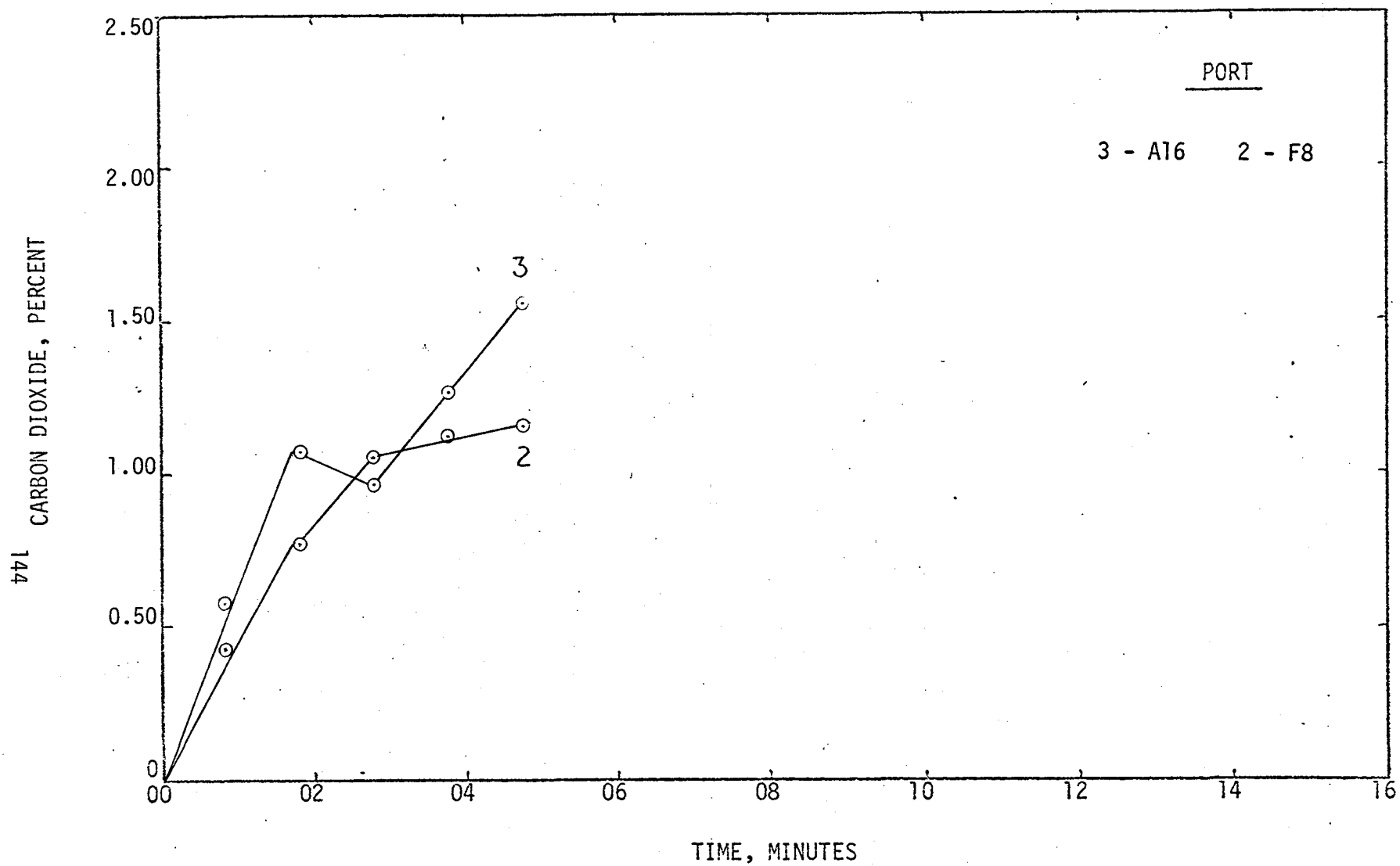


FIGURE 93 - CARBON DIOXIDE CONCENTRATIONS  
TEST 4



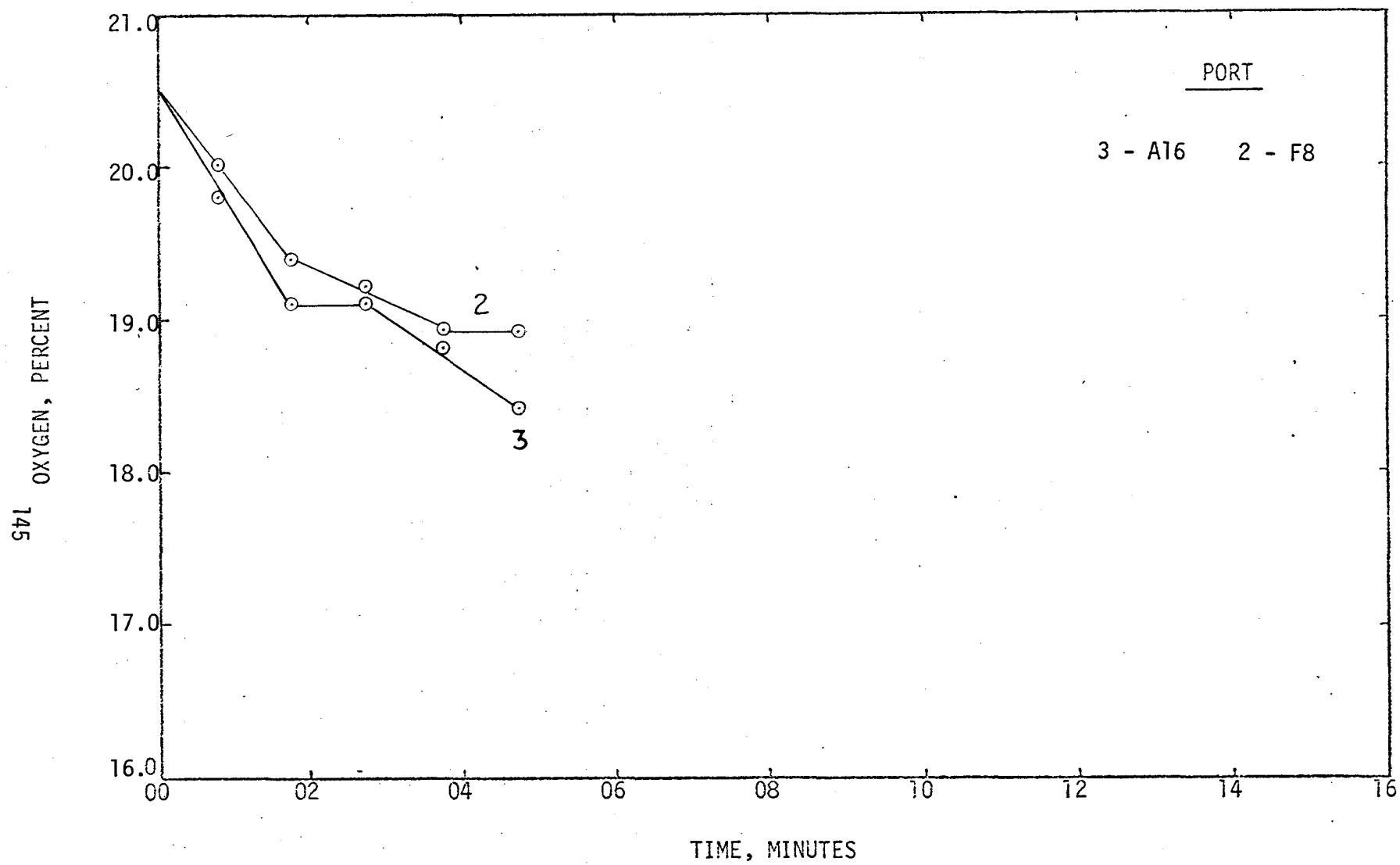


FIGURE 94 . - OXYGEN CONCENTRATIONS  
TEST 4

TEST 5

---

FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 5

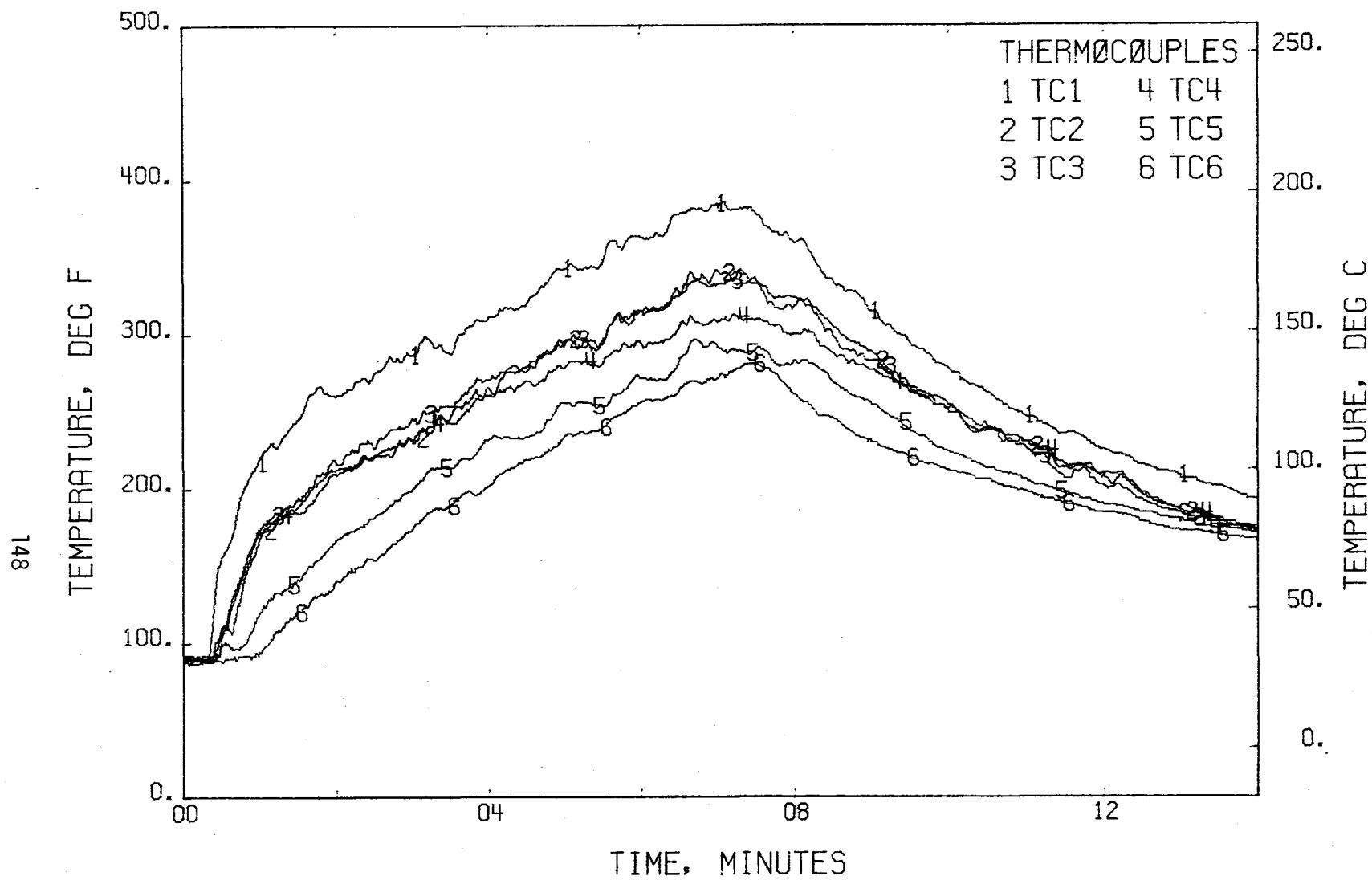


FIGURE 95 . - TEMPERATURES, T/C TREE 1  
TEST 5

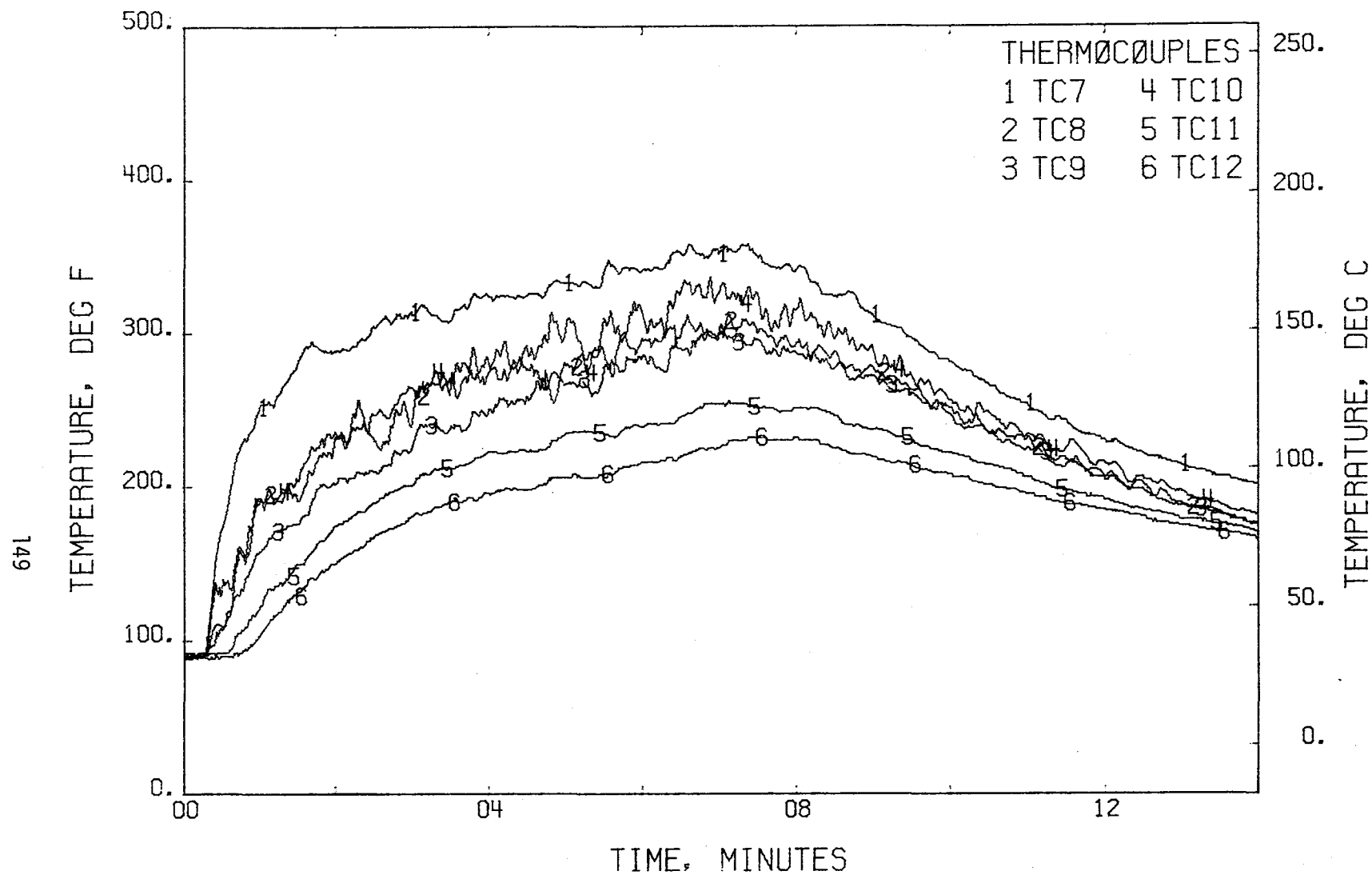


FIGURE 96 . - TEMPERATURES, T/C TREE 2  
TEST 5

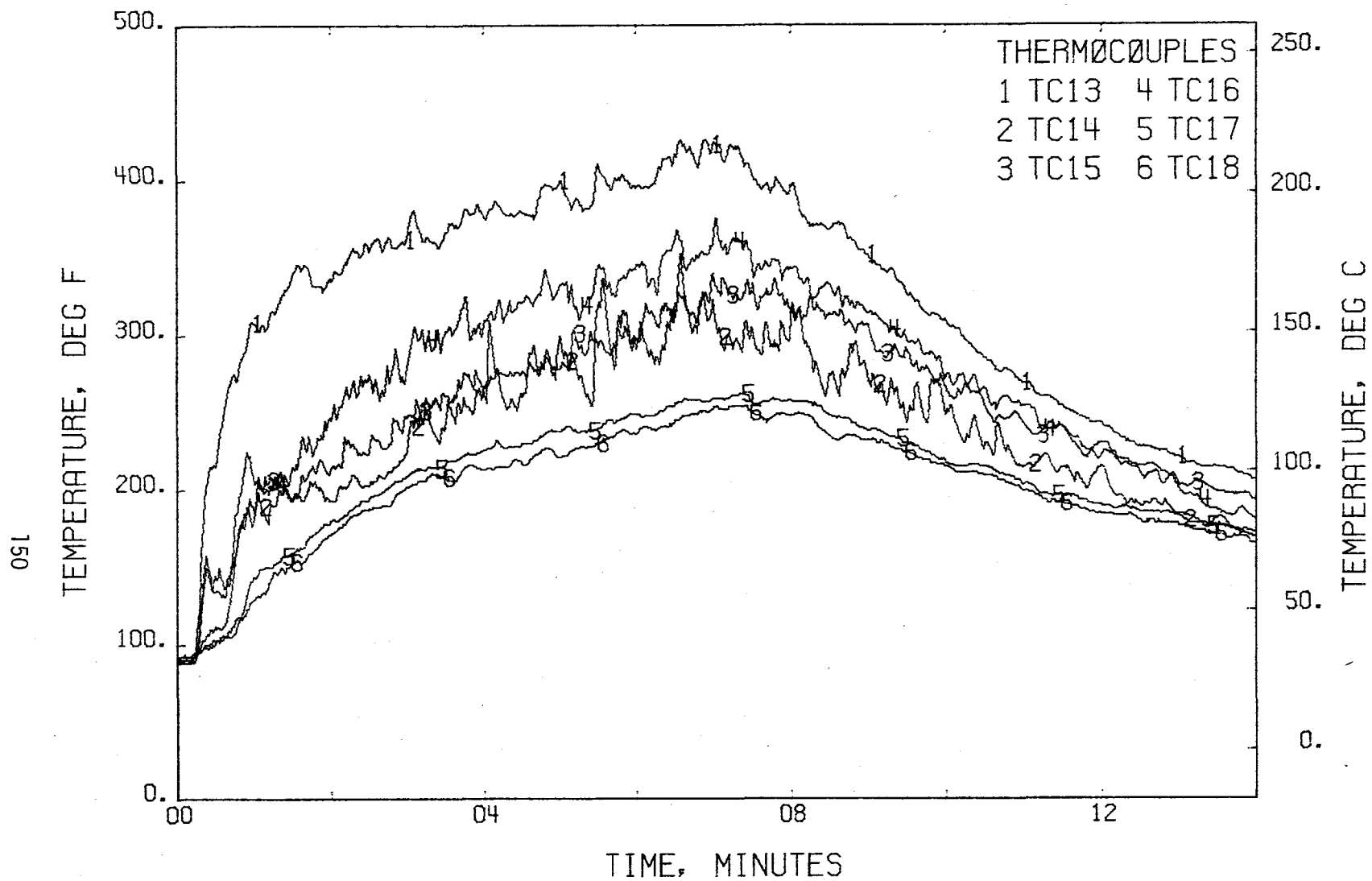


FIGURE 97 . - TEMPERATURES, T/C TREE 3  
TEST 5

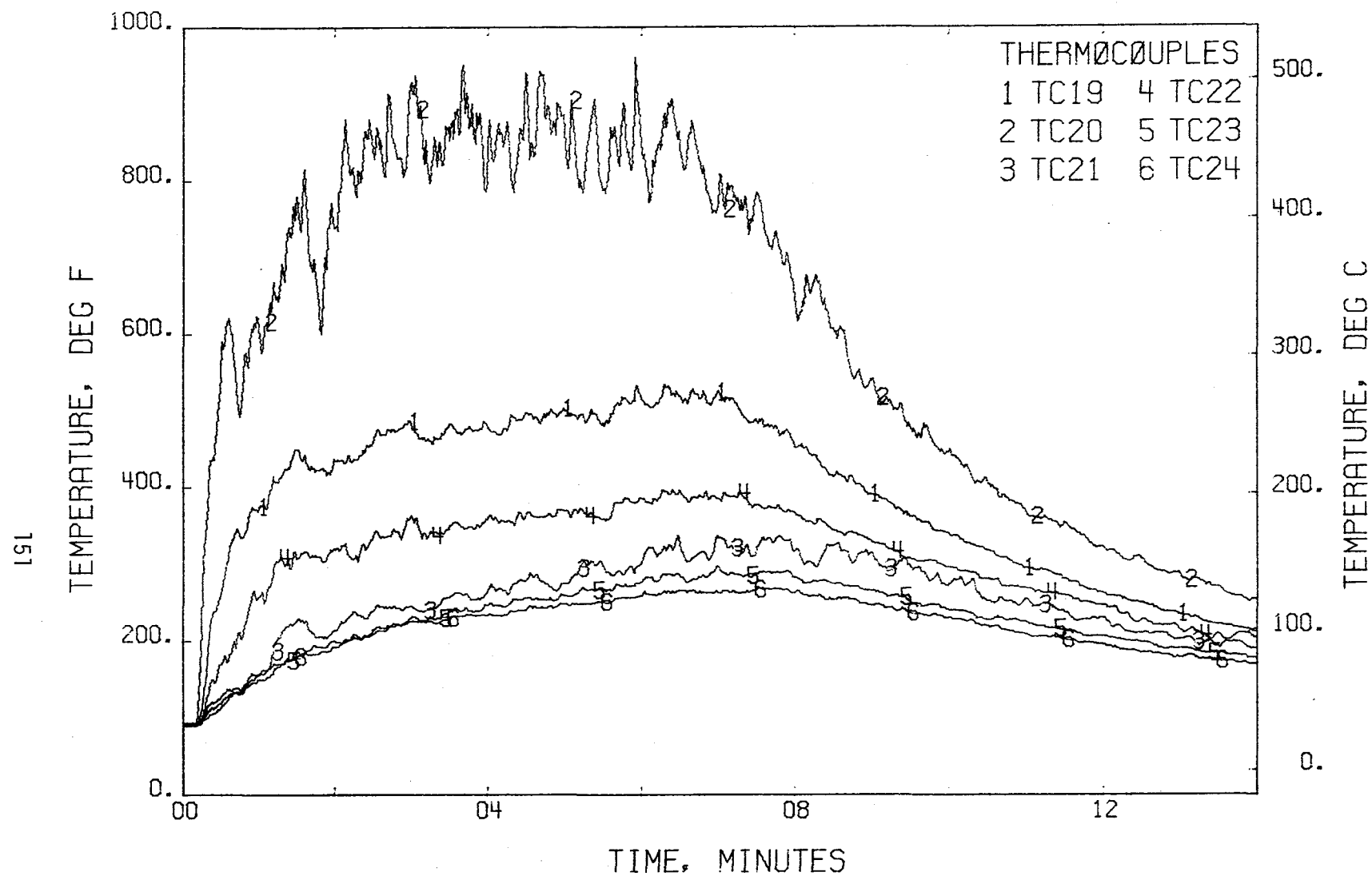


FIGURE 98 . - TEMPERATURES, T/C TREE 4  
TEST 5

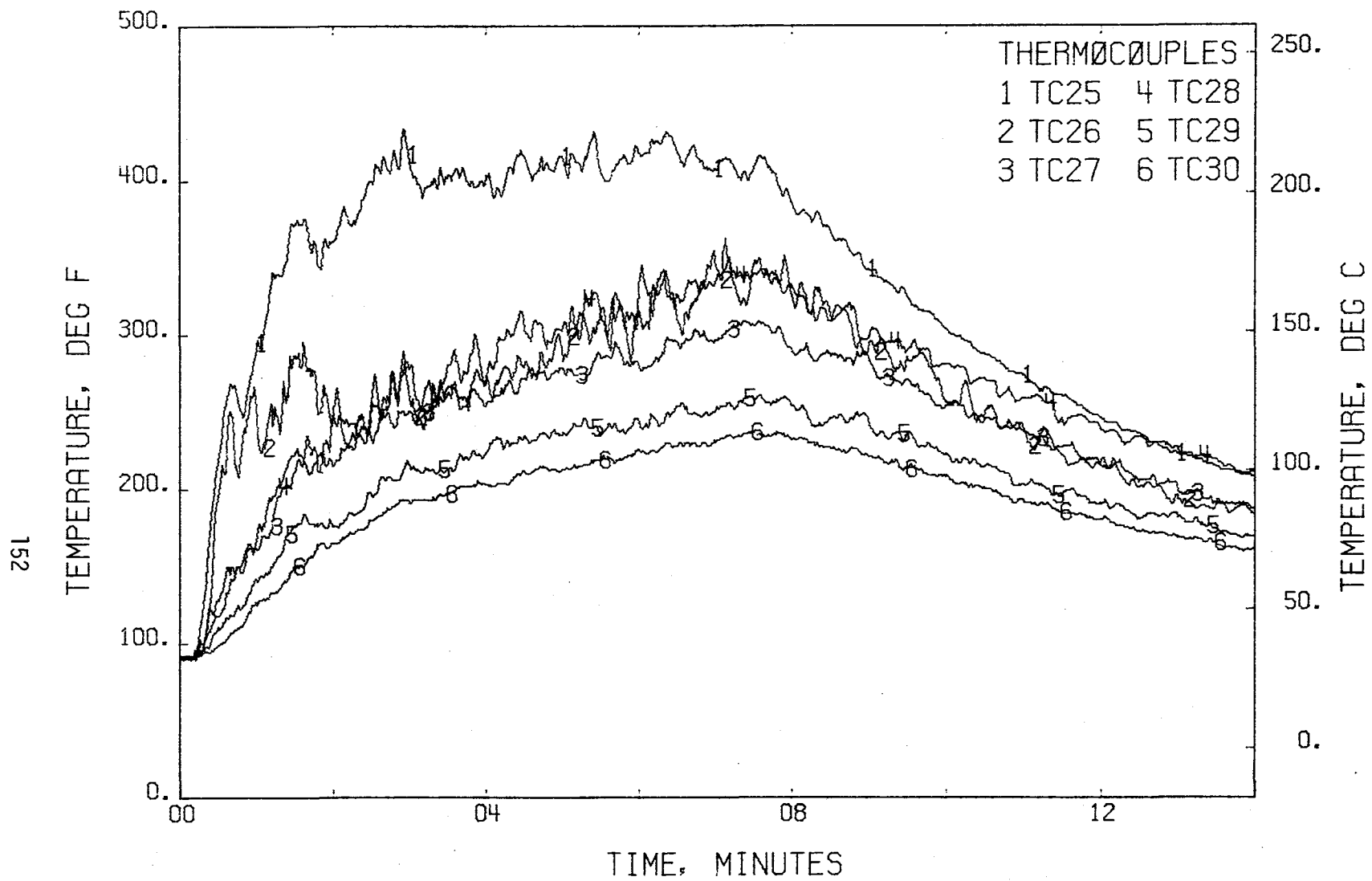


FIGURE 99 . - TEMPERATURES, T/C TREE 5  
TEST 5



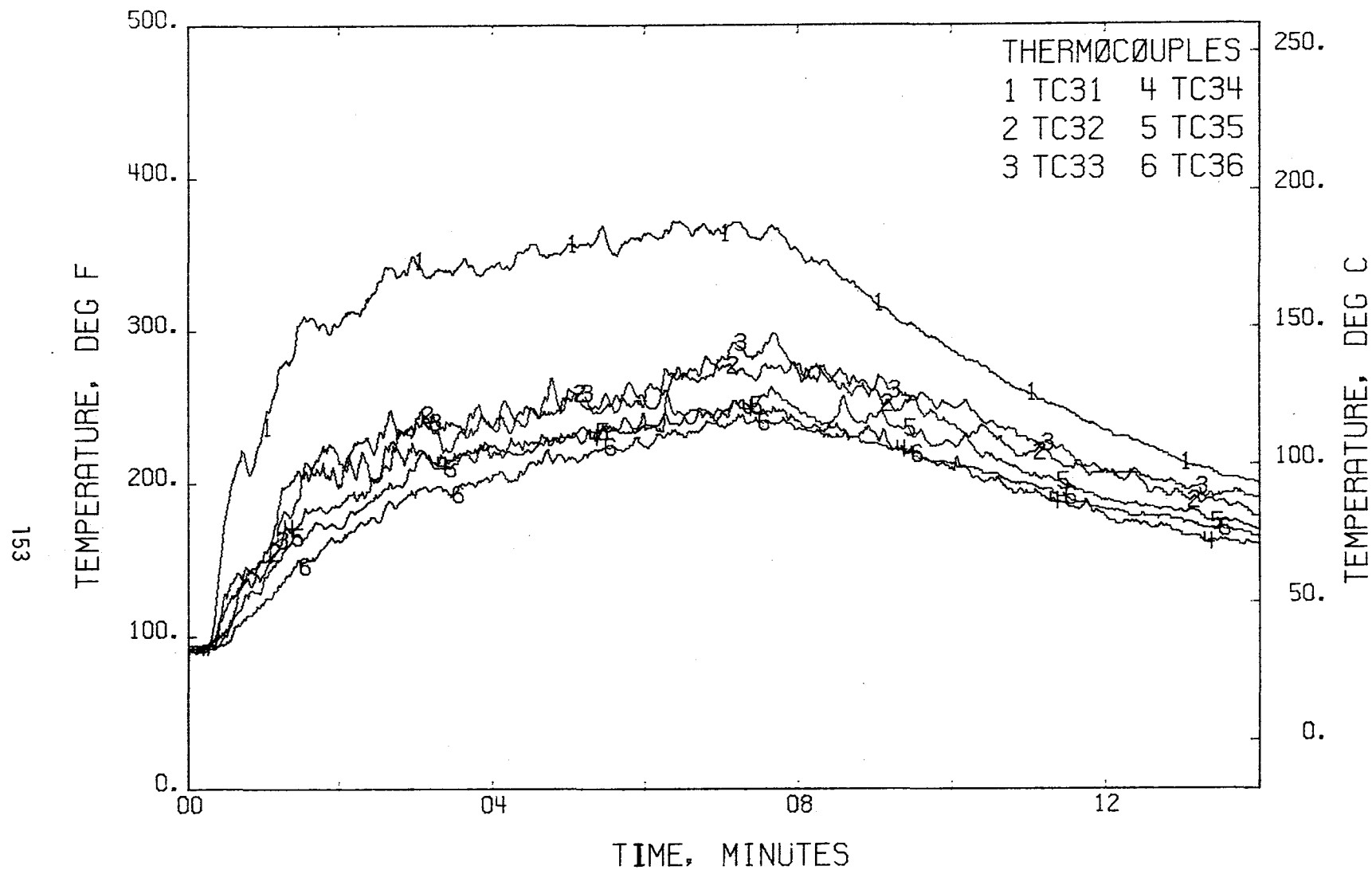


FIGURE 100 . - TEMPERATURES, T/C TREE 6  
TEST 5

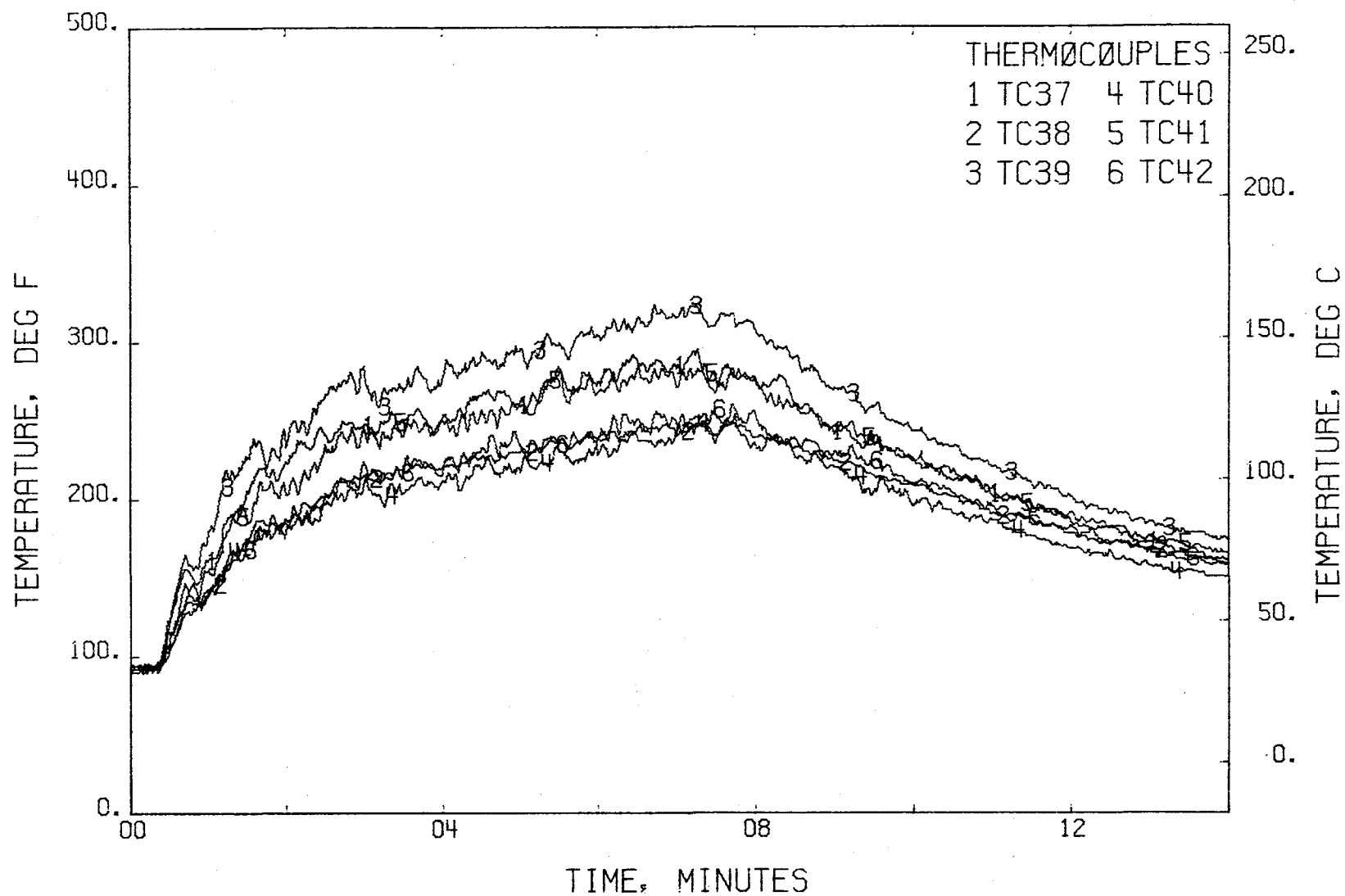


FIGURE 101 . - TEMPERATURES, T/C TREE 7  
TEST 5

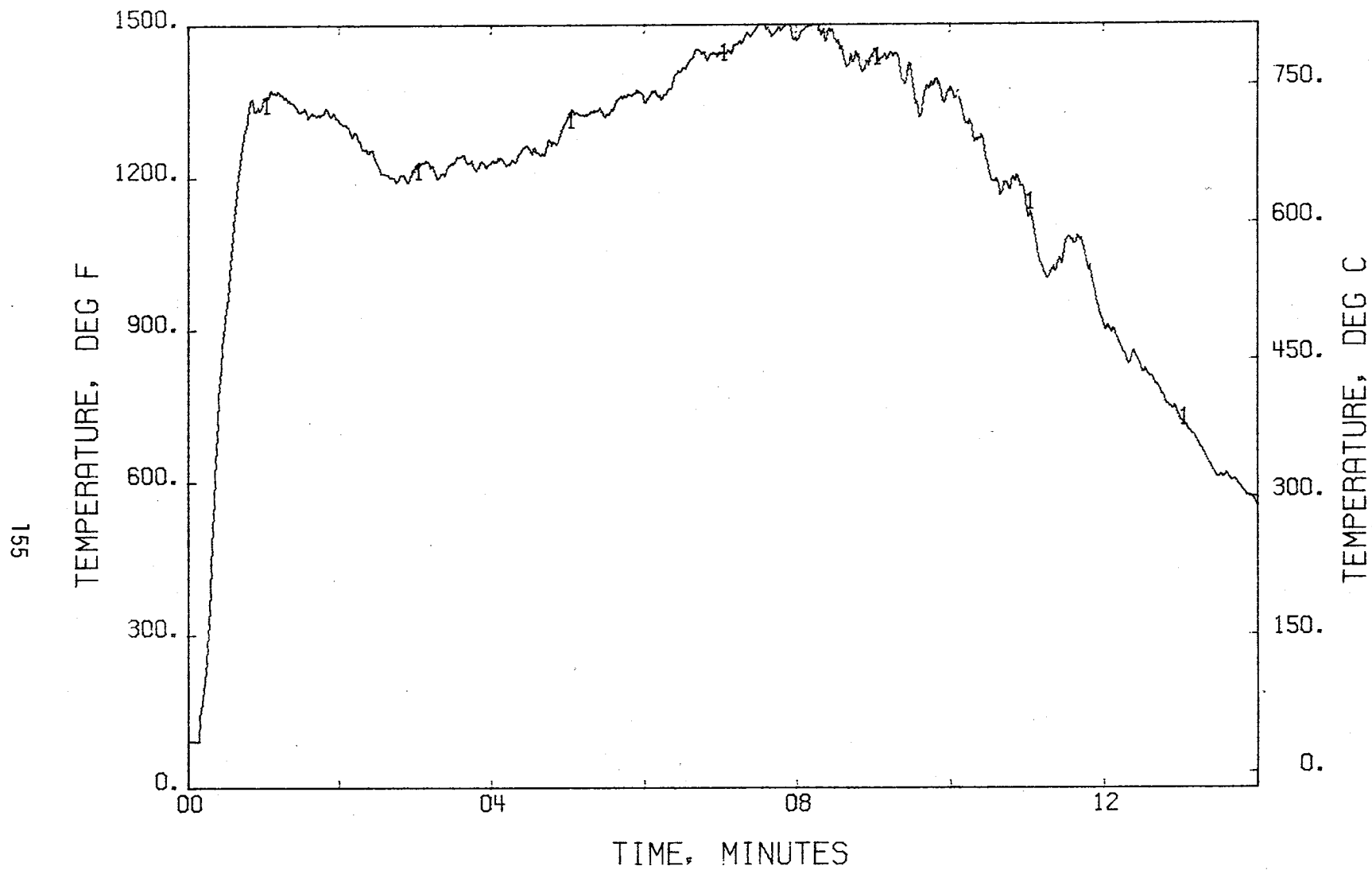


FIGURE 102 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 5

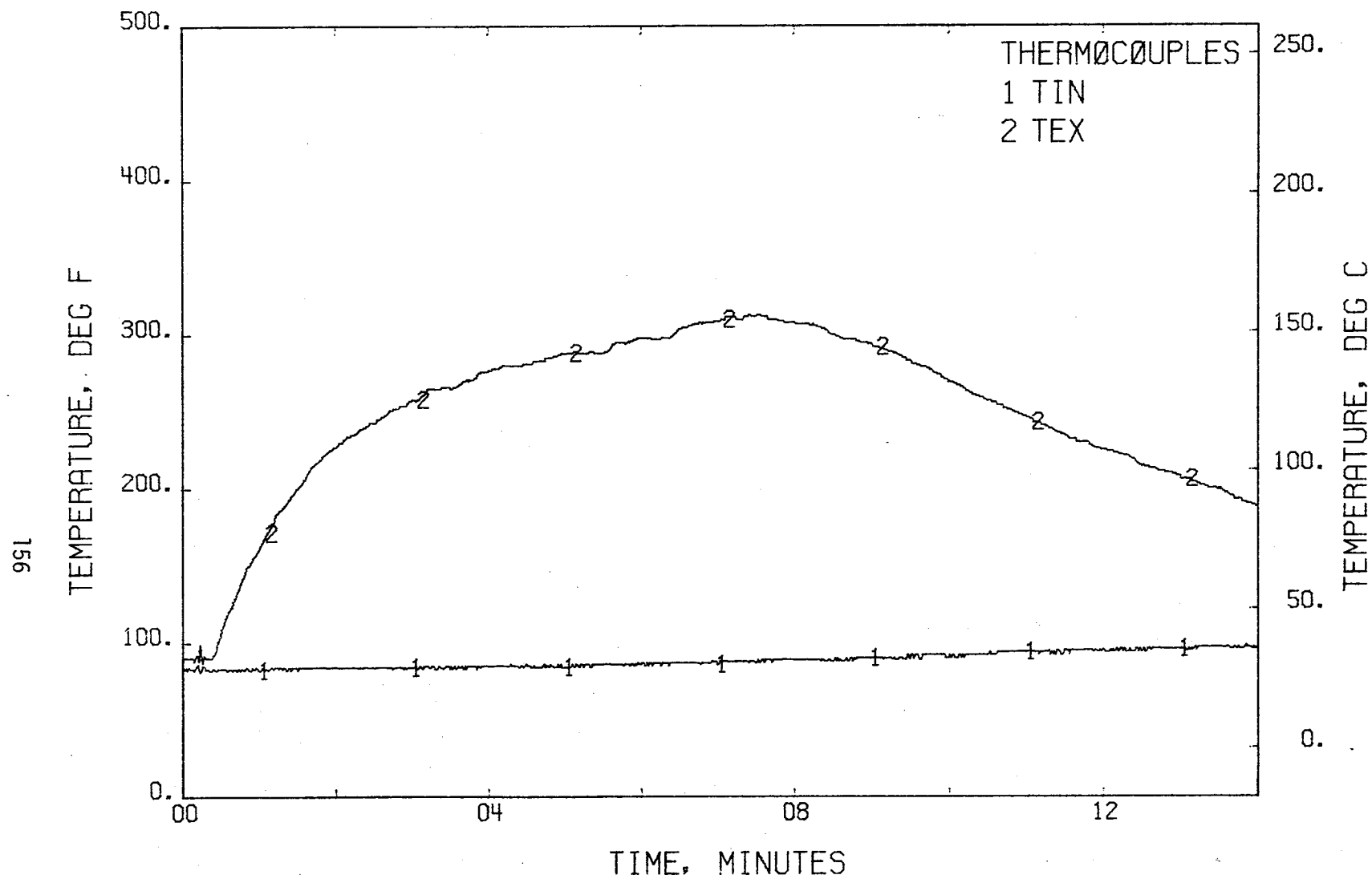


FIGURE 103 . - TEMPERATURES, INLET + EXIT  
TEST 5

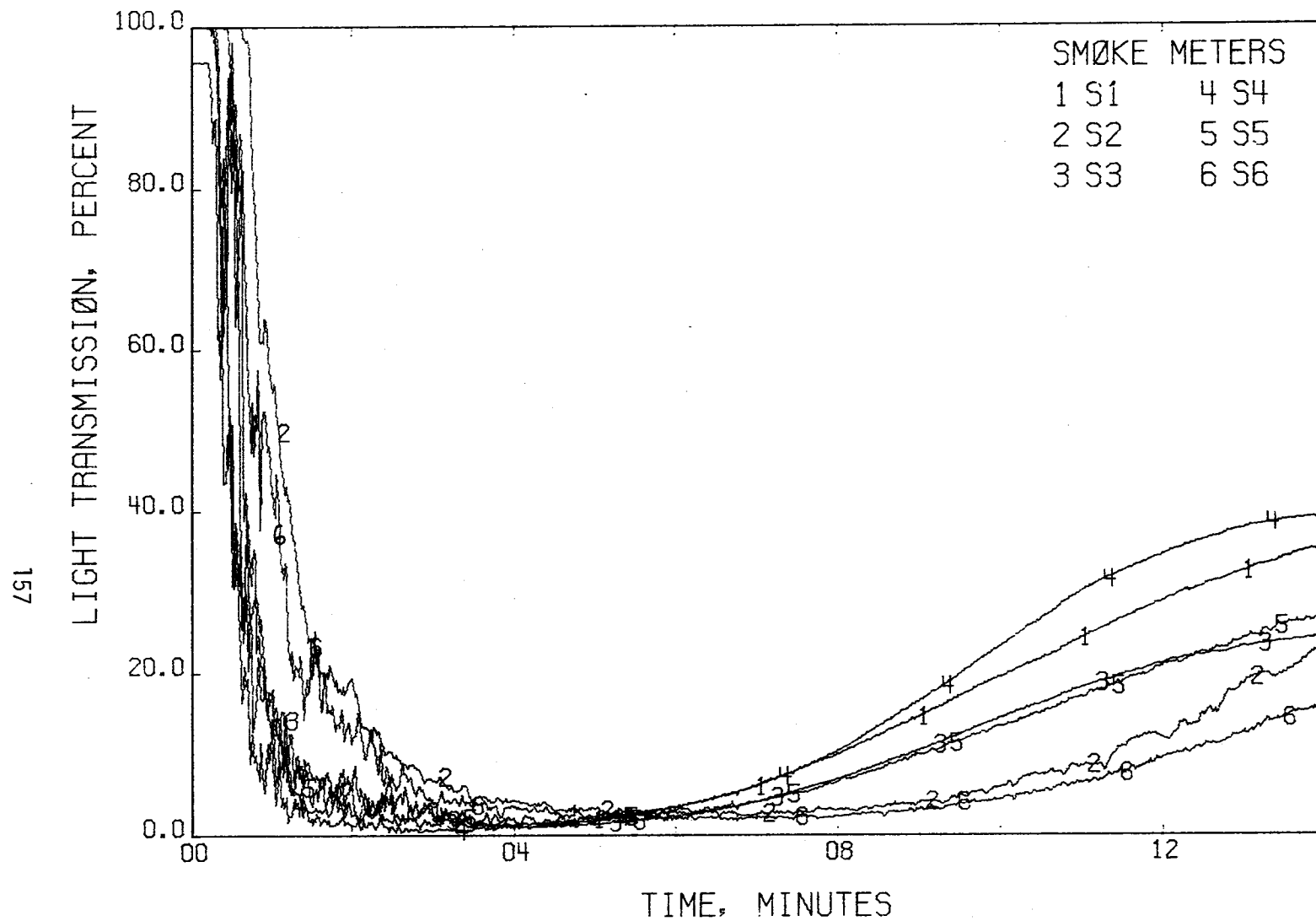


FIGURE 104 . - LIGHT TRANSMISSION  
TEST 5

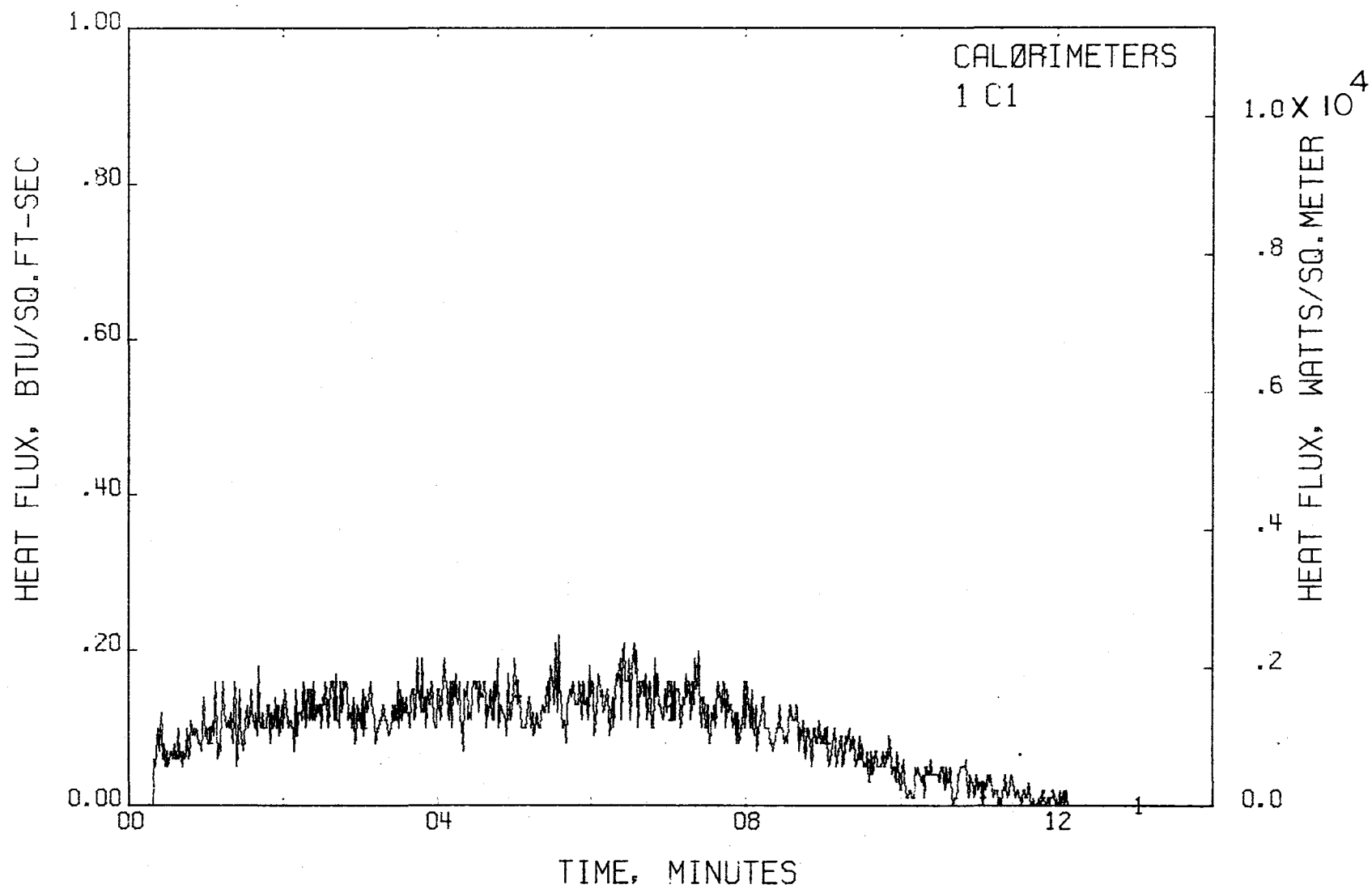


FIGURE 105 . - HEAT FLUX, AFT  
TEST 5

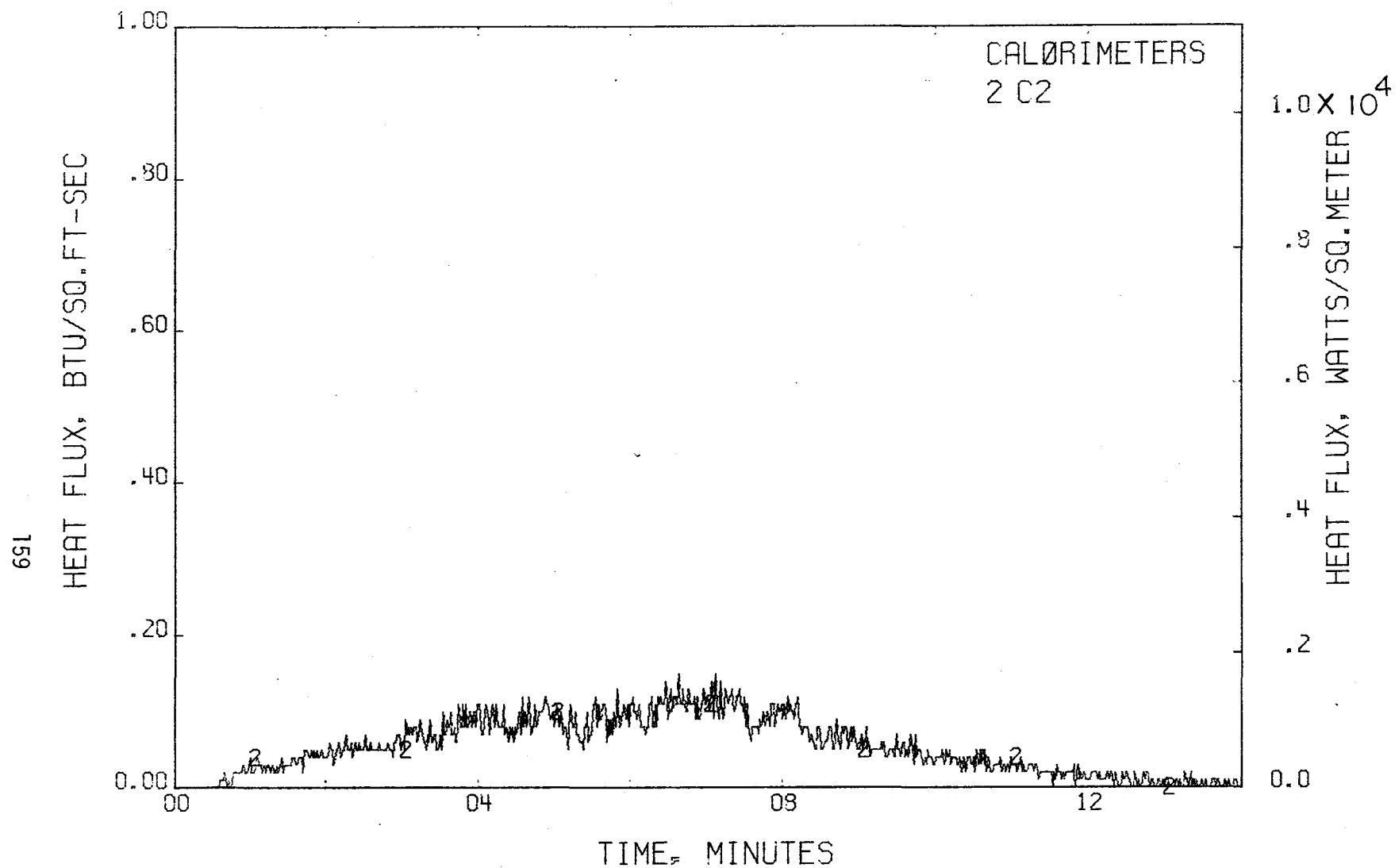


FIGURE 105 . - HEAT FLUX, AFT - CONTINUED  
TEST 5

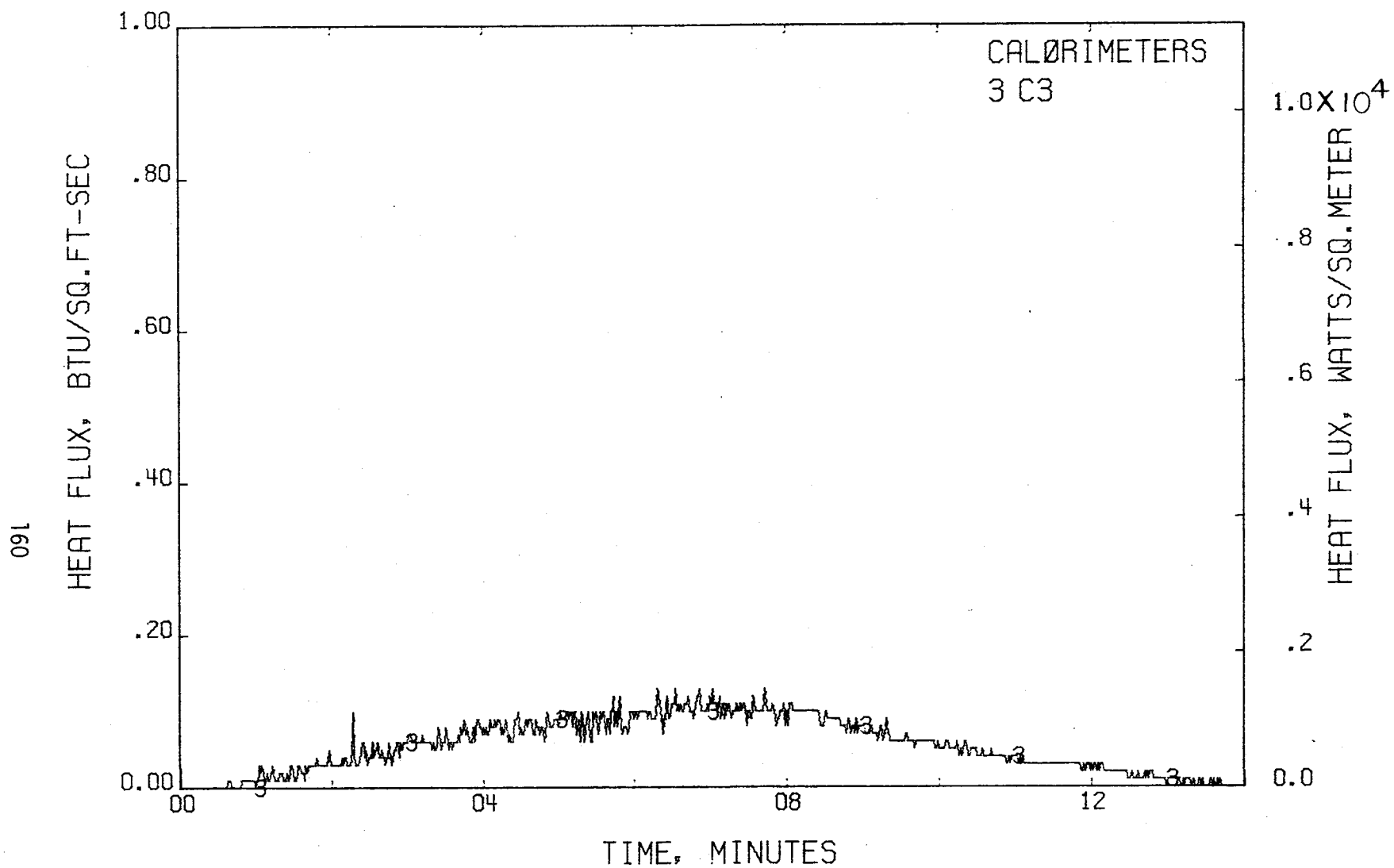


FIGURE 105 . - HEAT FLUX, AFT - CONTINUED  
TEST 5



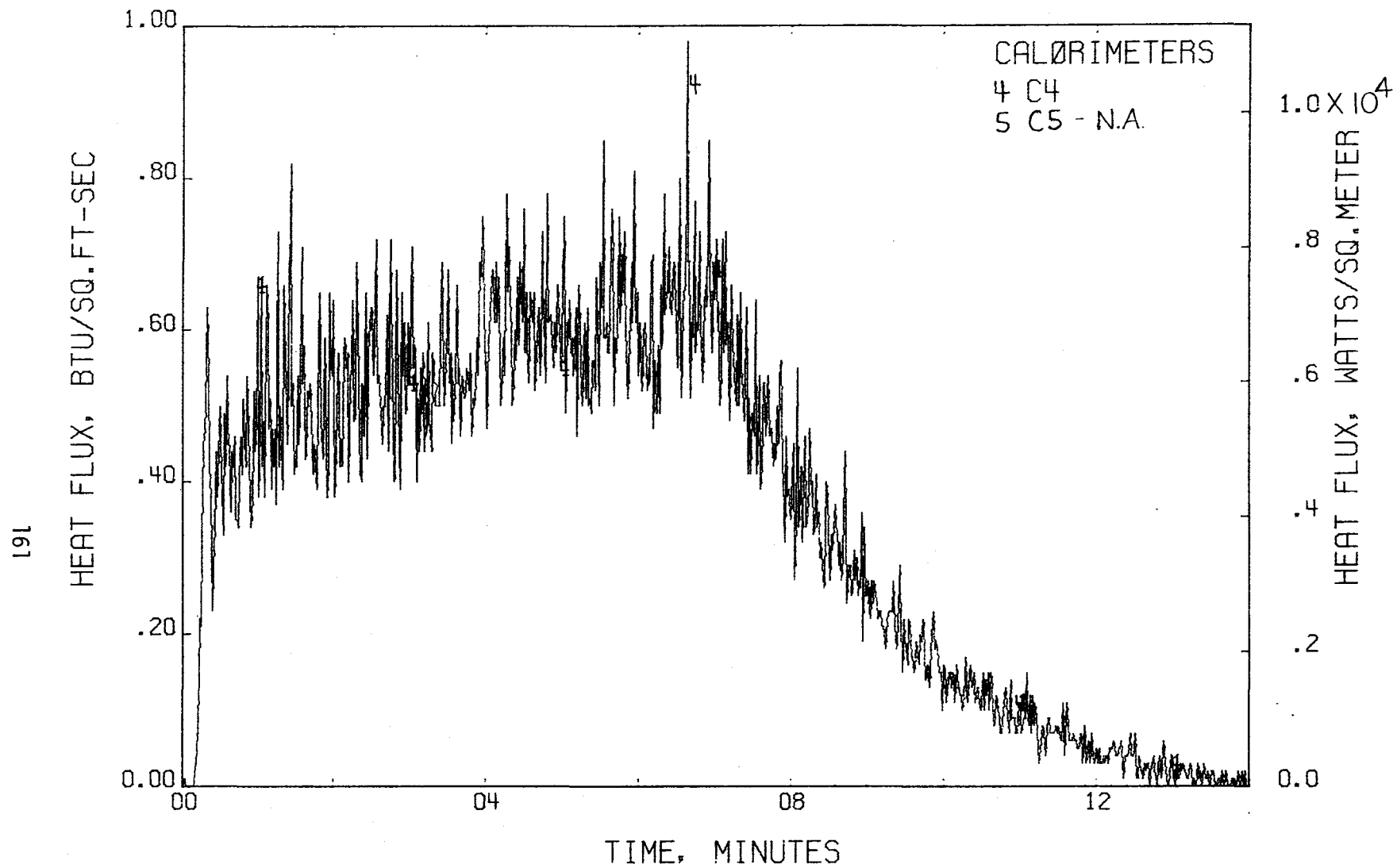


FIGURE 106 . - HEAT FLUX, MIDSECTION  
TEST 5

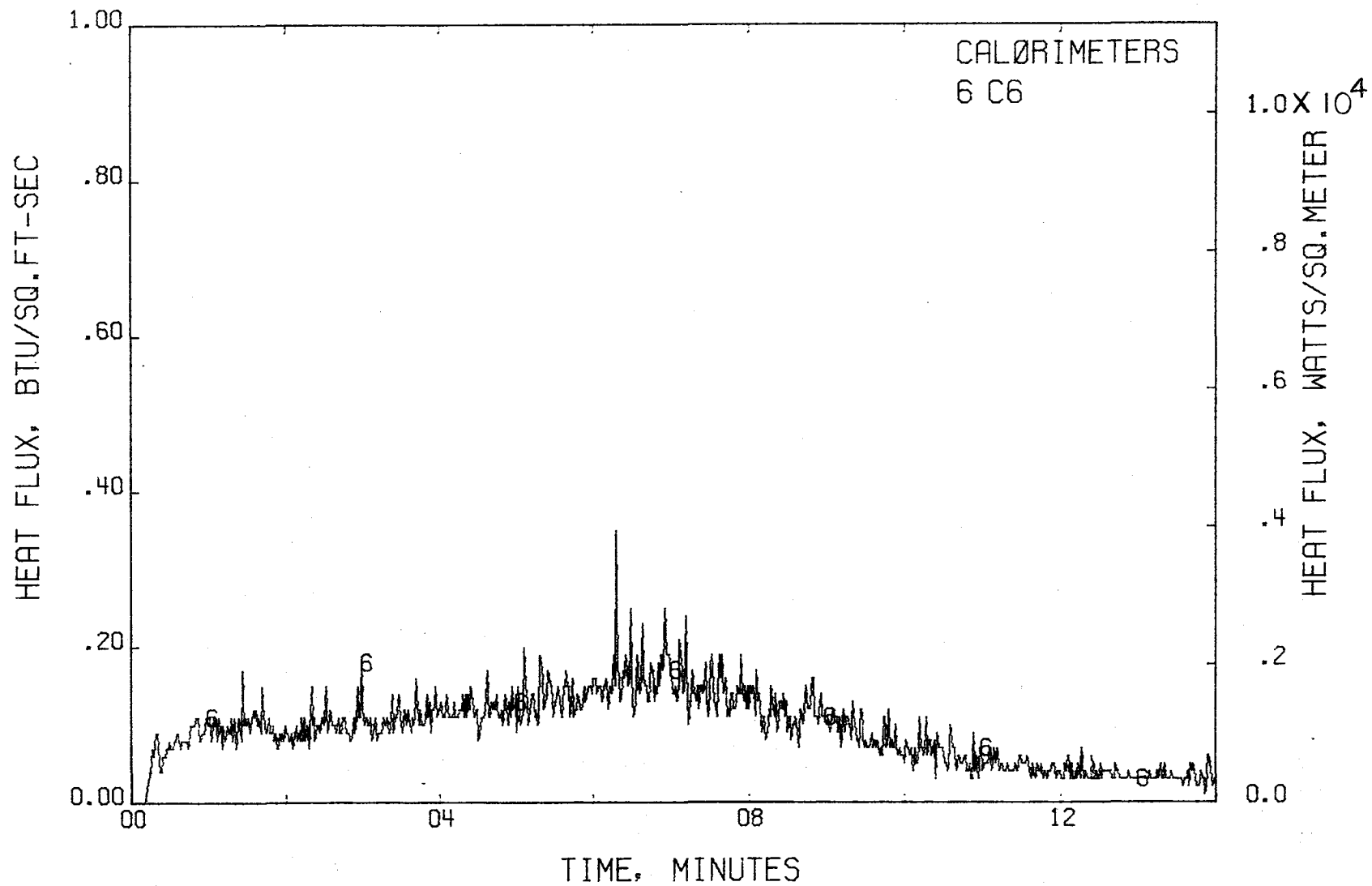


FIGURE 106 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 5

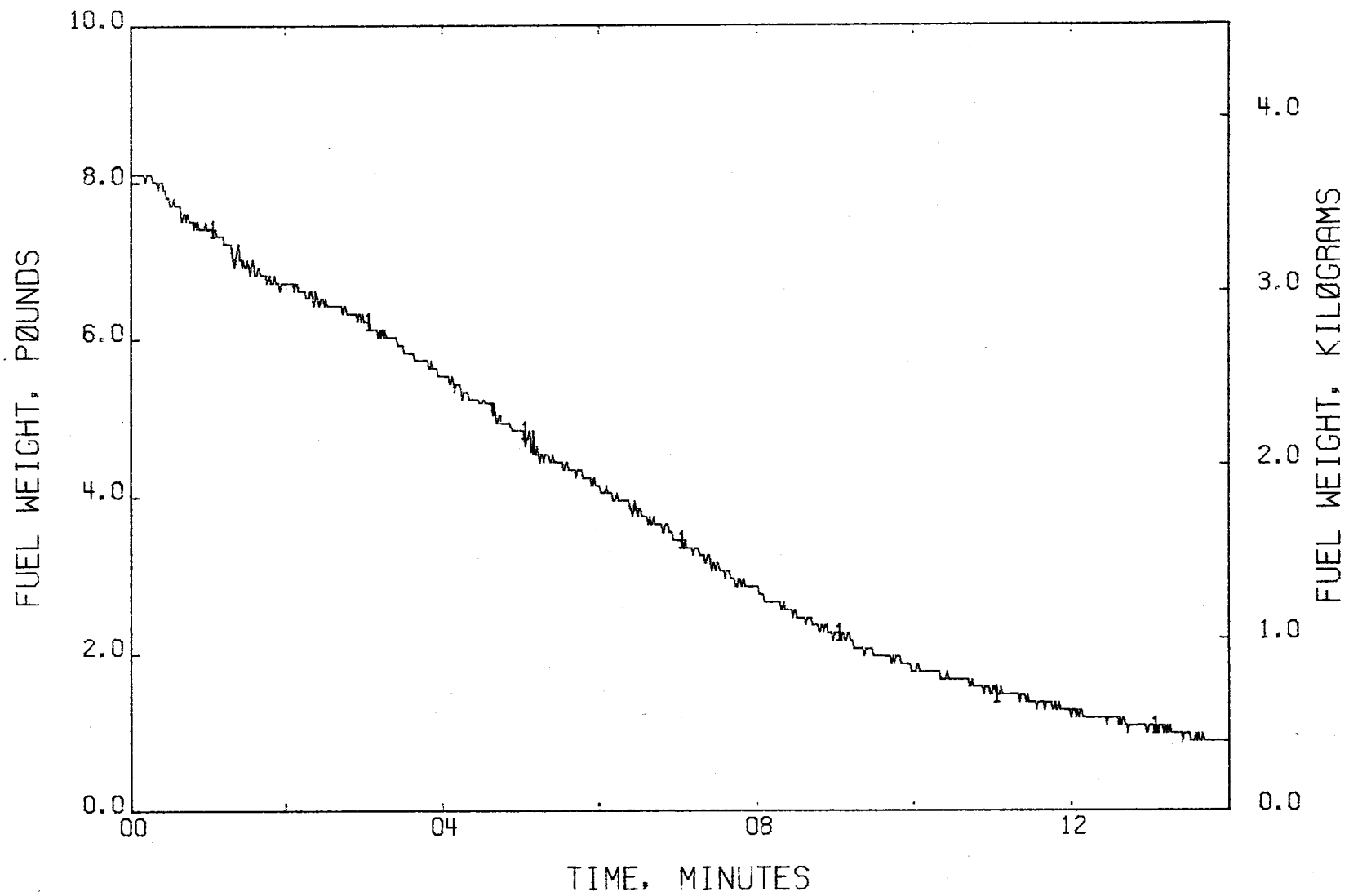


FIGURE 107 . - FUEL WEIGHT LOSS  
TEST 5

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM

HYDROGEN FLUORIDE - <12 PPM

HYDROGEN CHLORIDE - <24 PPM

FIGURE 108 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 5

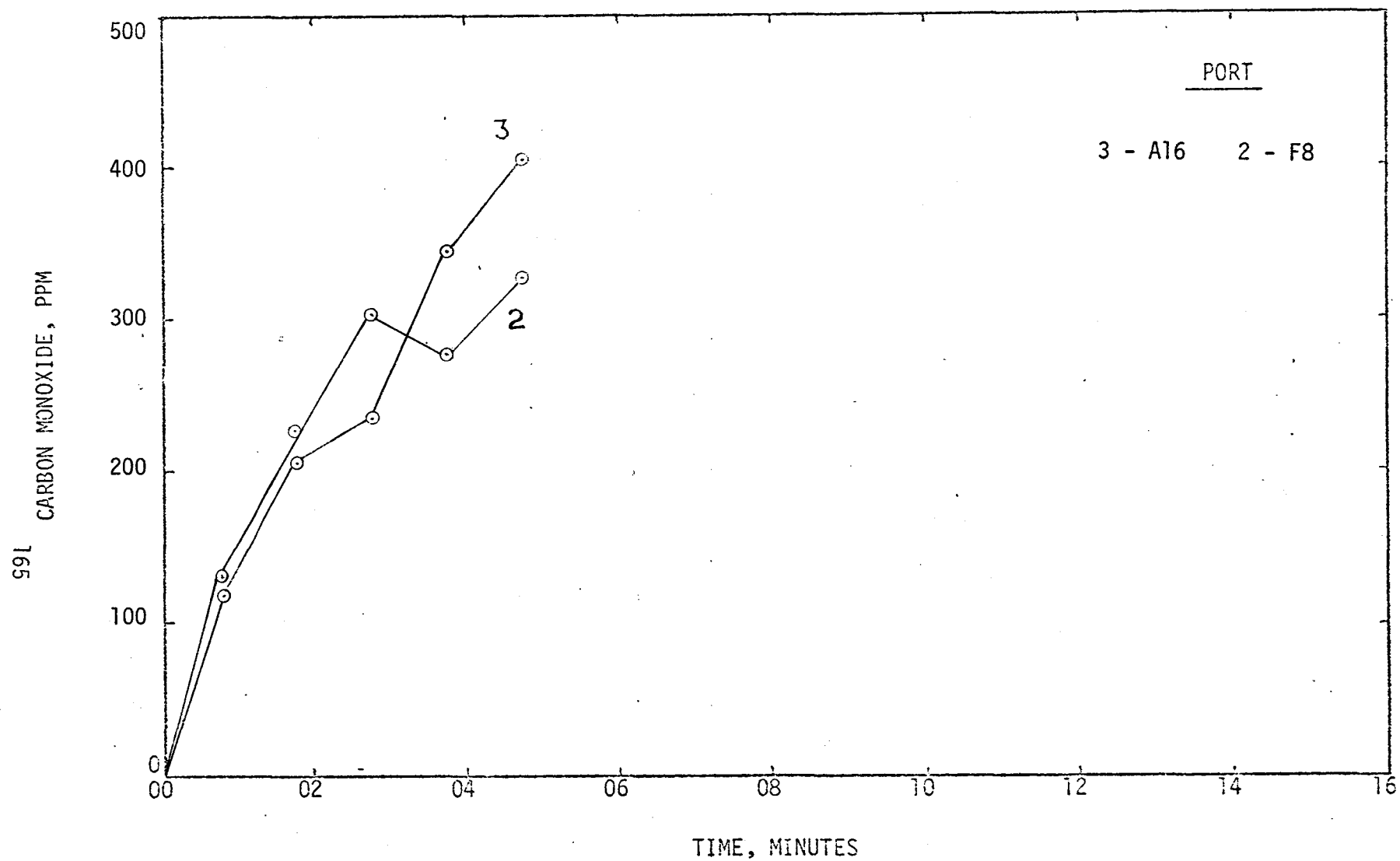


FIGURE 109 . - CARBON MONOXIDE CONCENTRATIONS  
TEST 5

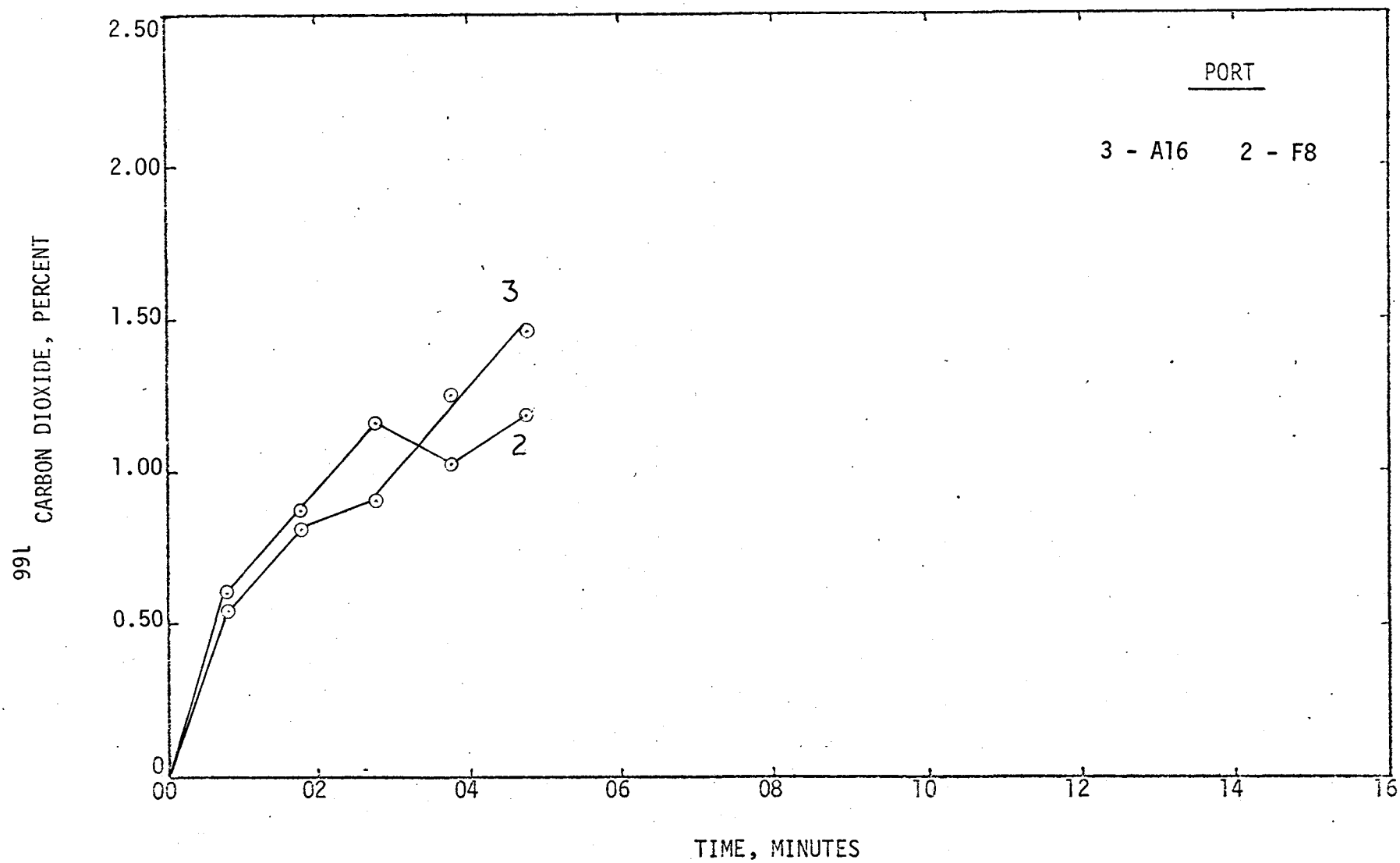


FIGURE 110 - CARBON DIOXIDE CONCENTRATIONS  
TEST 5

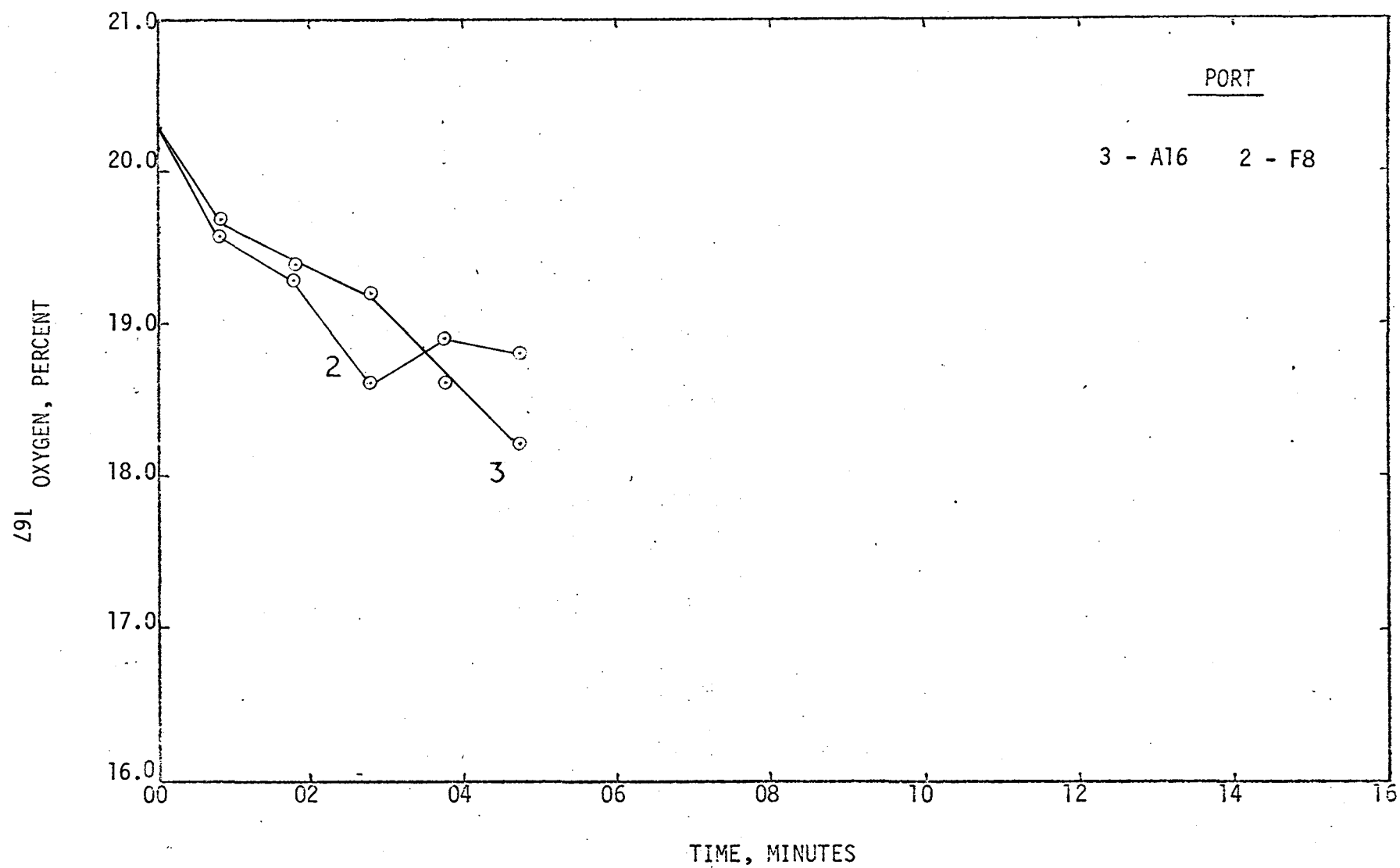


FIGURE 111 - OXYGEN CONCENTRATIONS  
TEST 5

TEST 6  

---

FUEL ONLY



NO PHOTOS WERE TAKEN FOR TEST 6

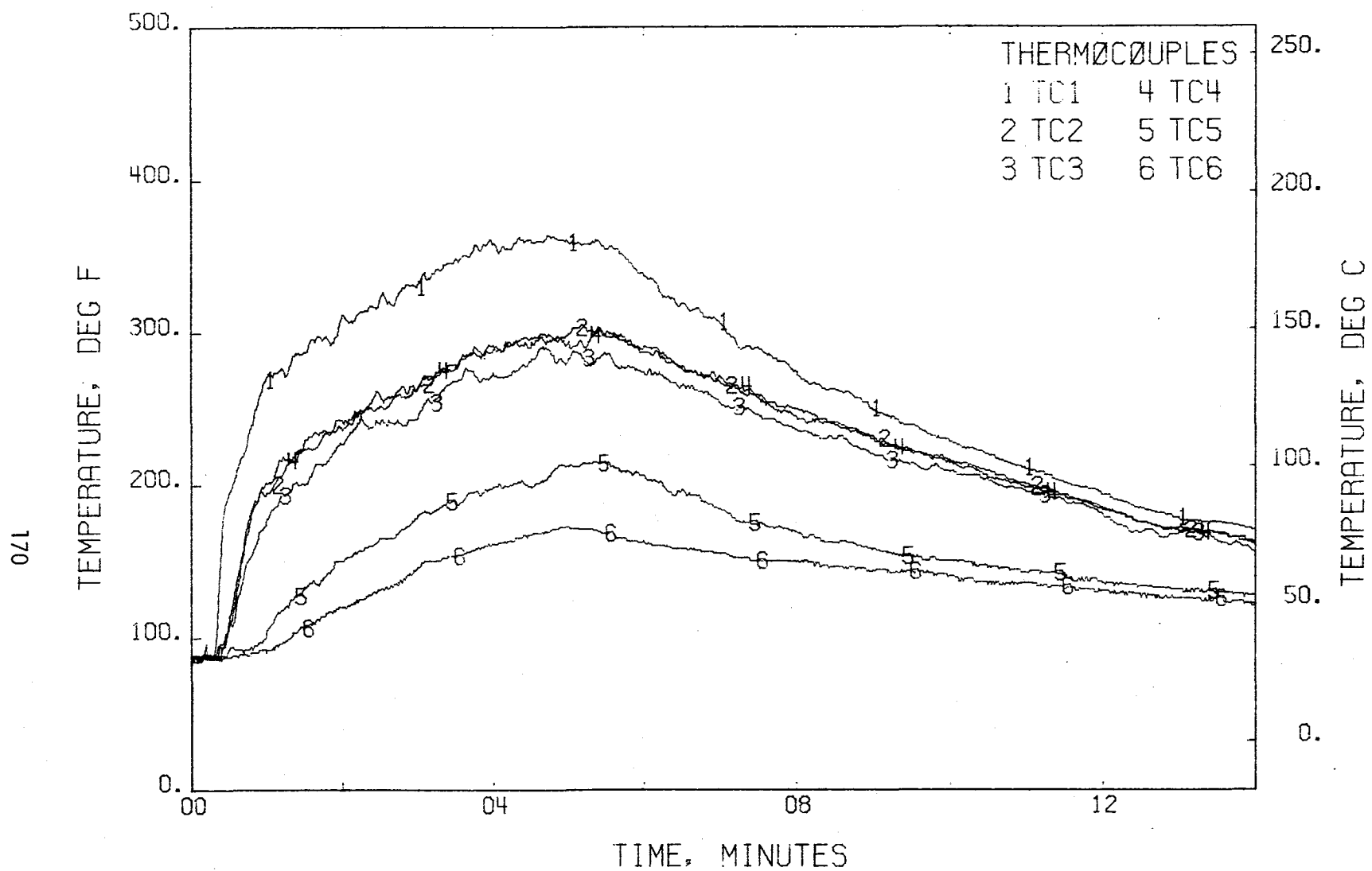


FIGURE 112 . - TEMPERATURES, T/C TREE 1  
TEST 6

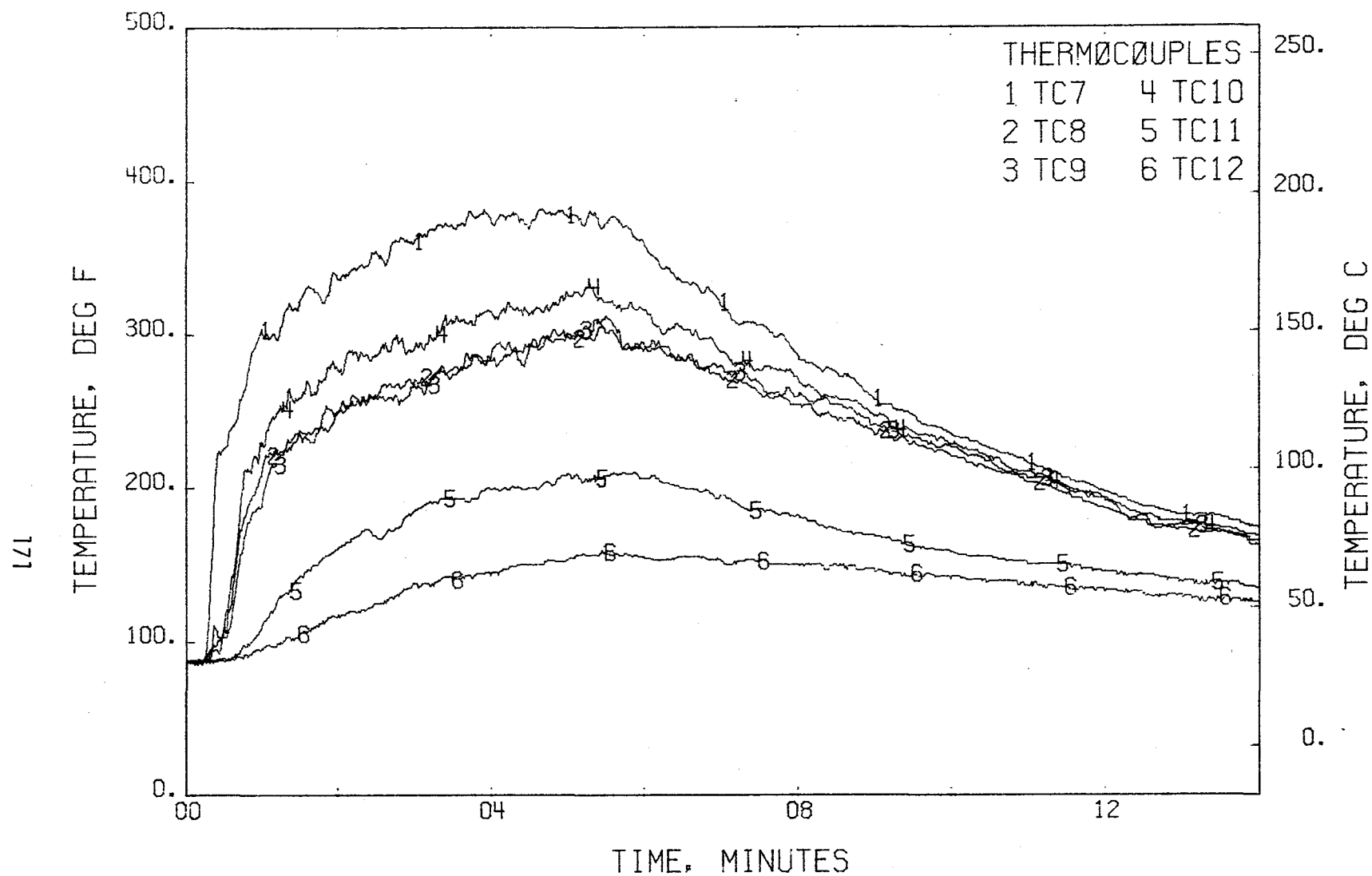


FIGURE 113 . - TEMPERATURES, T/C TREE 2  
TEST 6

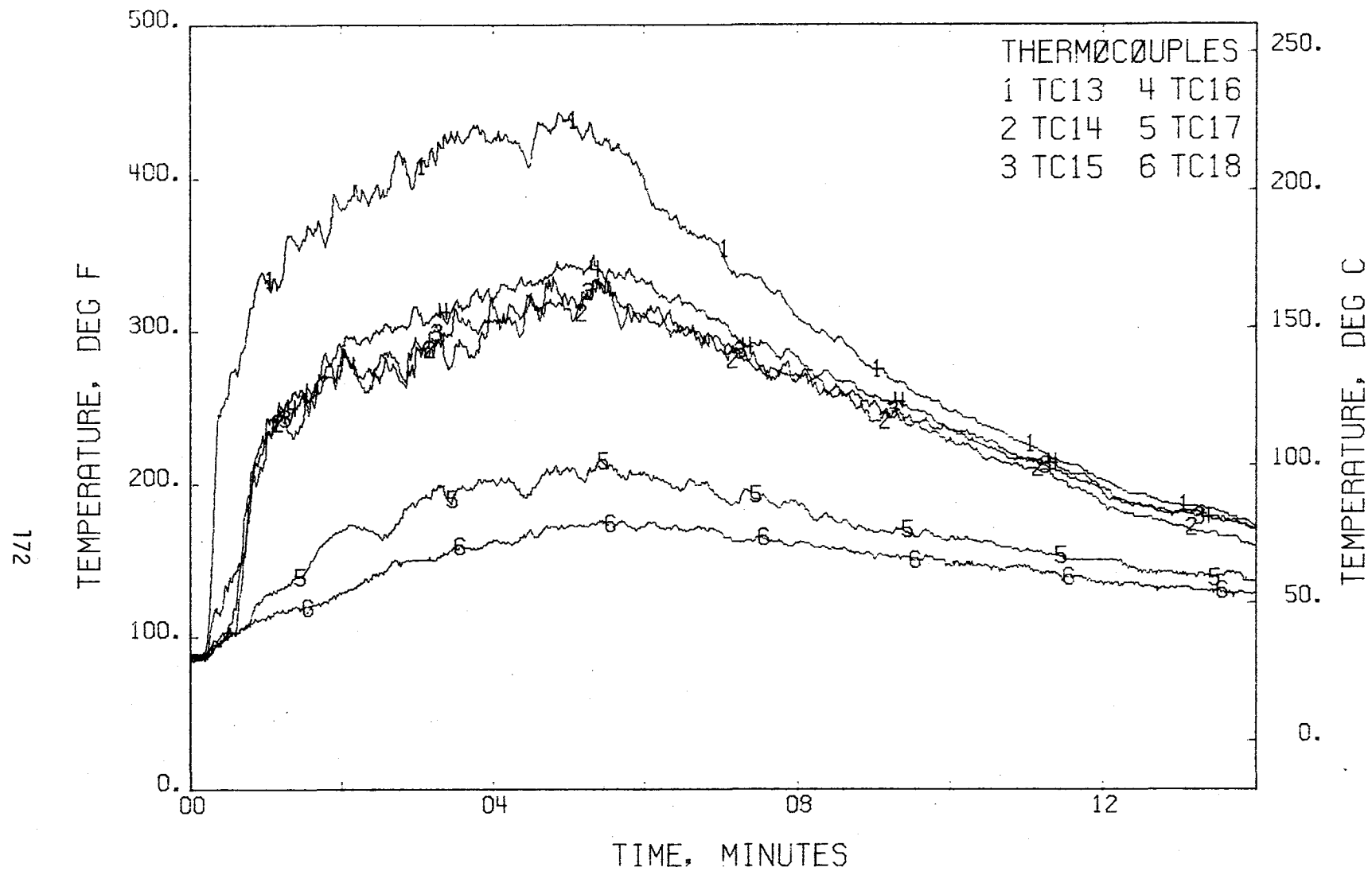


FIGURE 114 . - TEMPERATURES, T/C TREE 3  
TEST 6

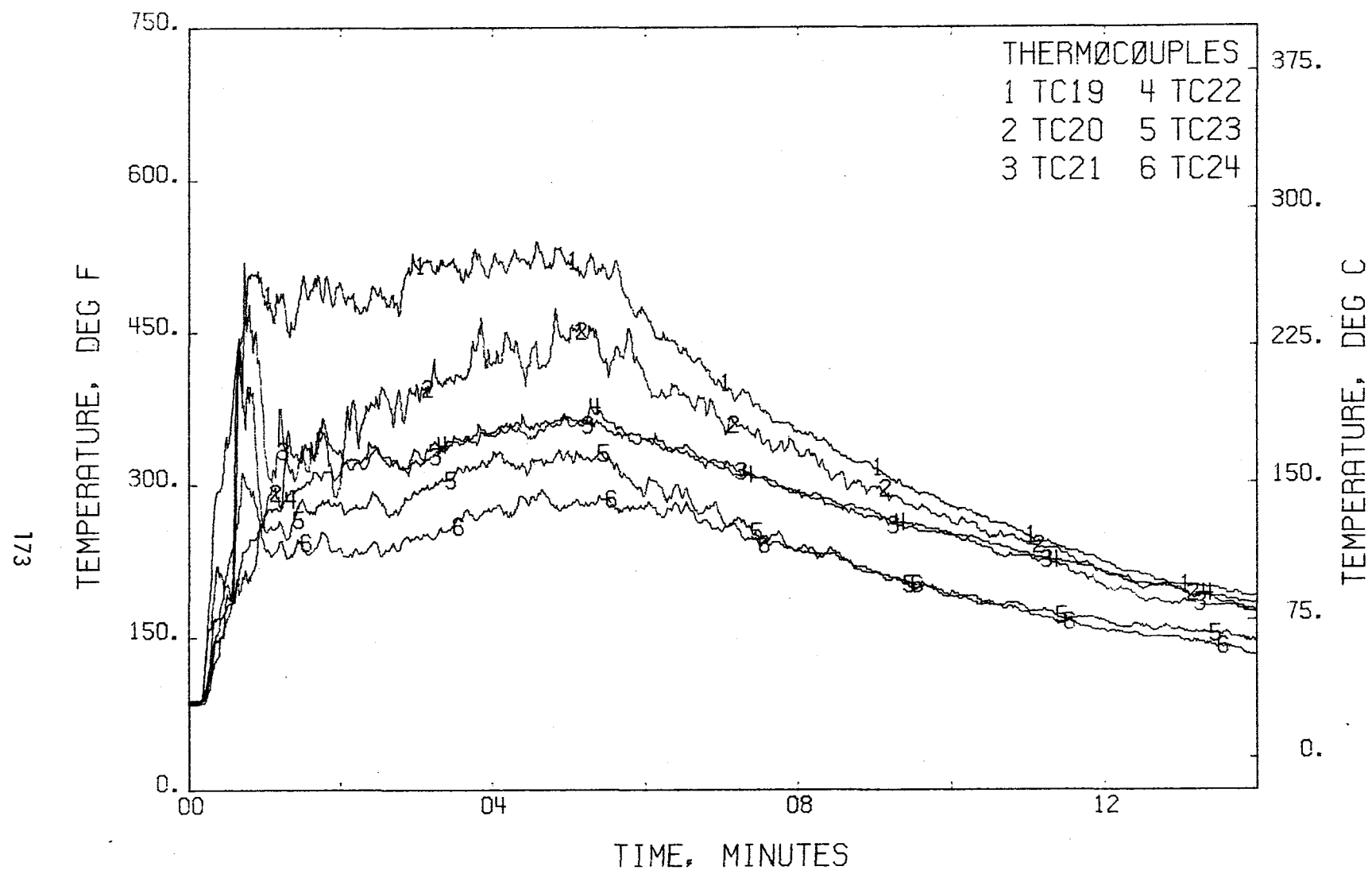


FIGURE 115 . - TEMPERATURES, T/C TREE 4  
TEST 6

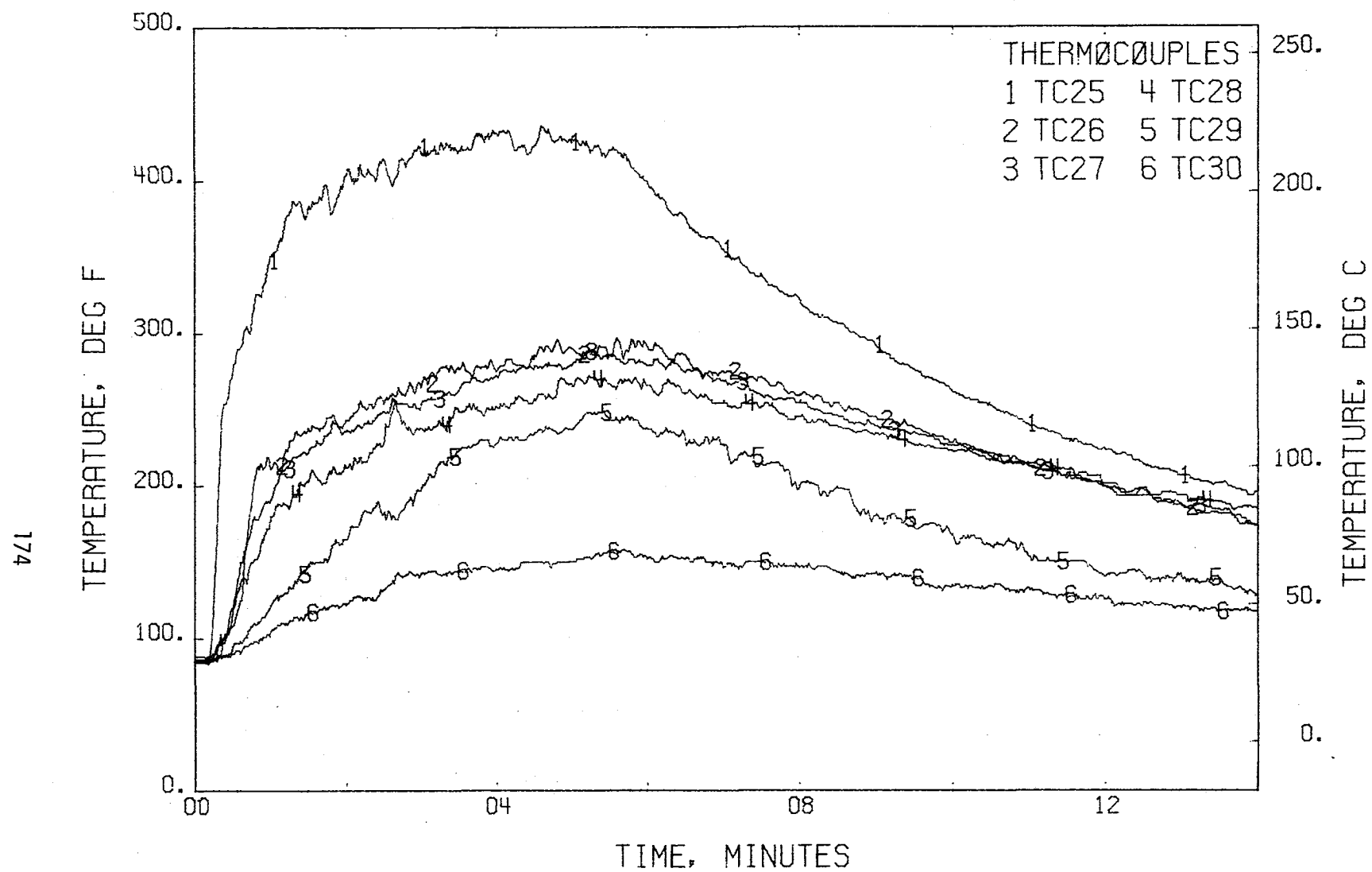


FIGURE 116 . - TEMPERATURES, T/C TREE 5  
TEST 6

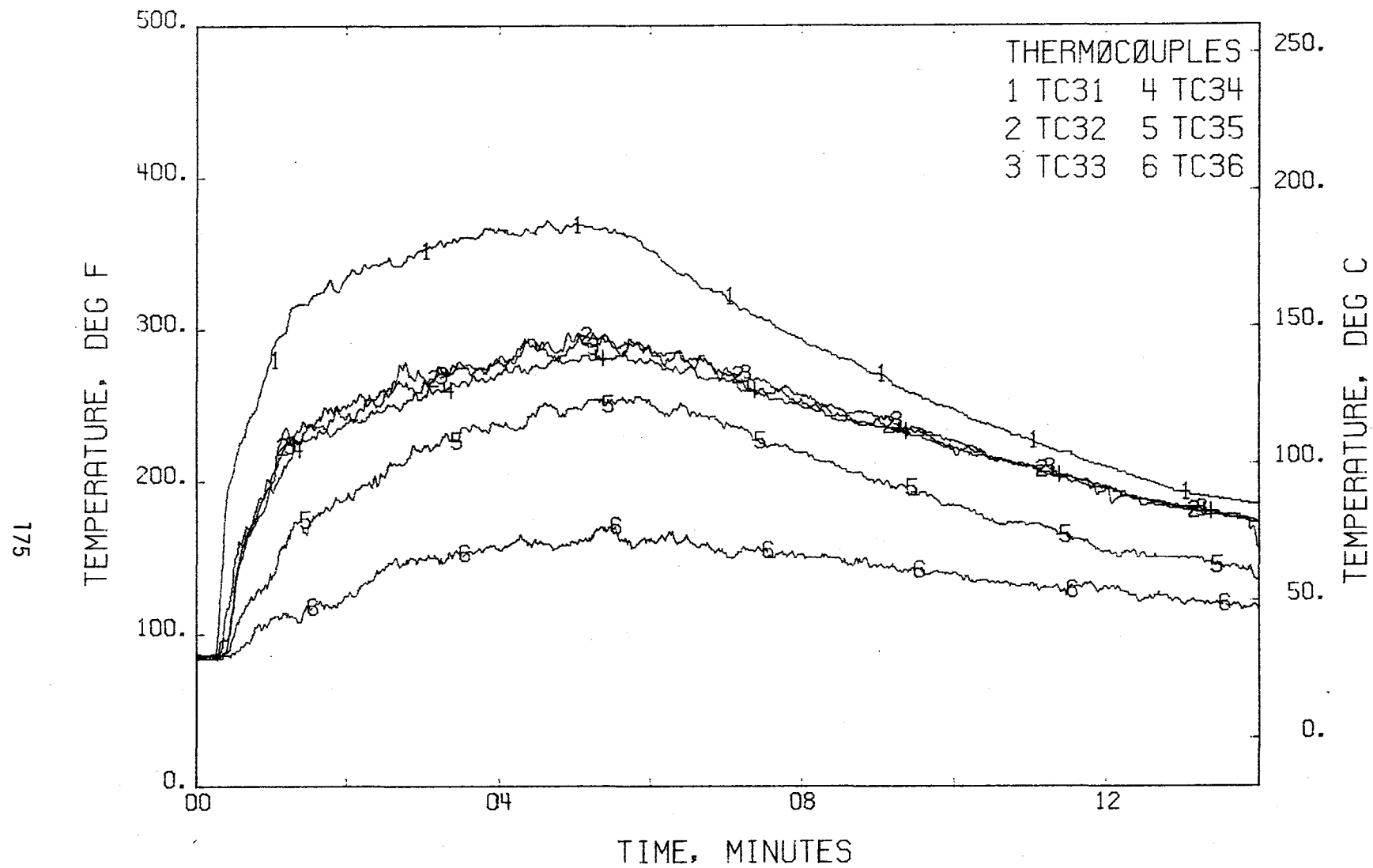


FIGURE 117 . - TEMPERATURES, T/C TREE 6  
TEST 6

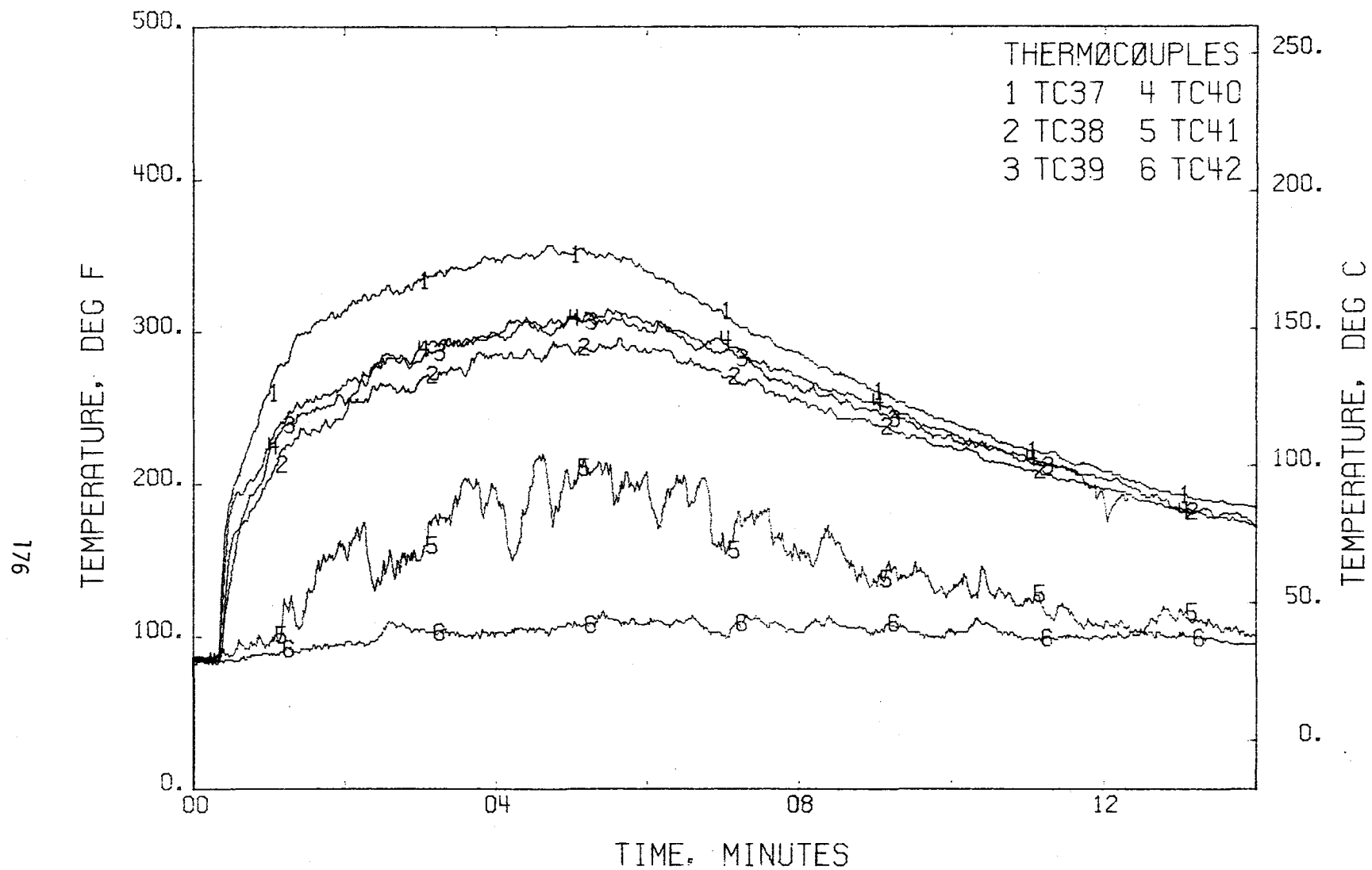


FIGURE 118 . - TEMPERATURES, T/C TREE 7  
TEST 6



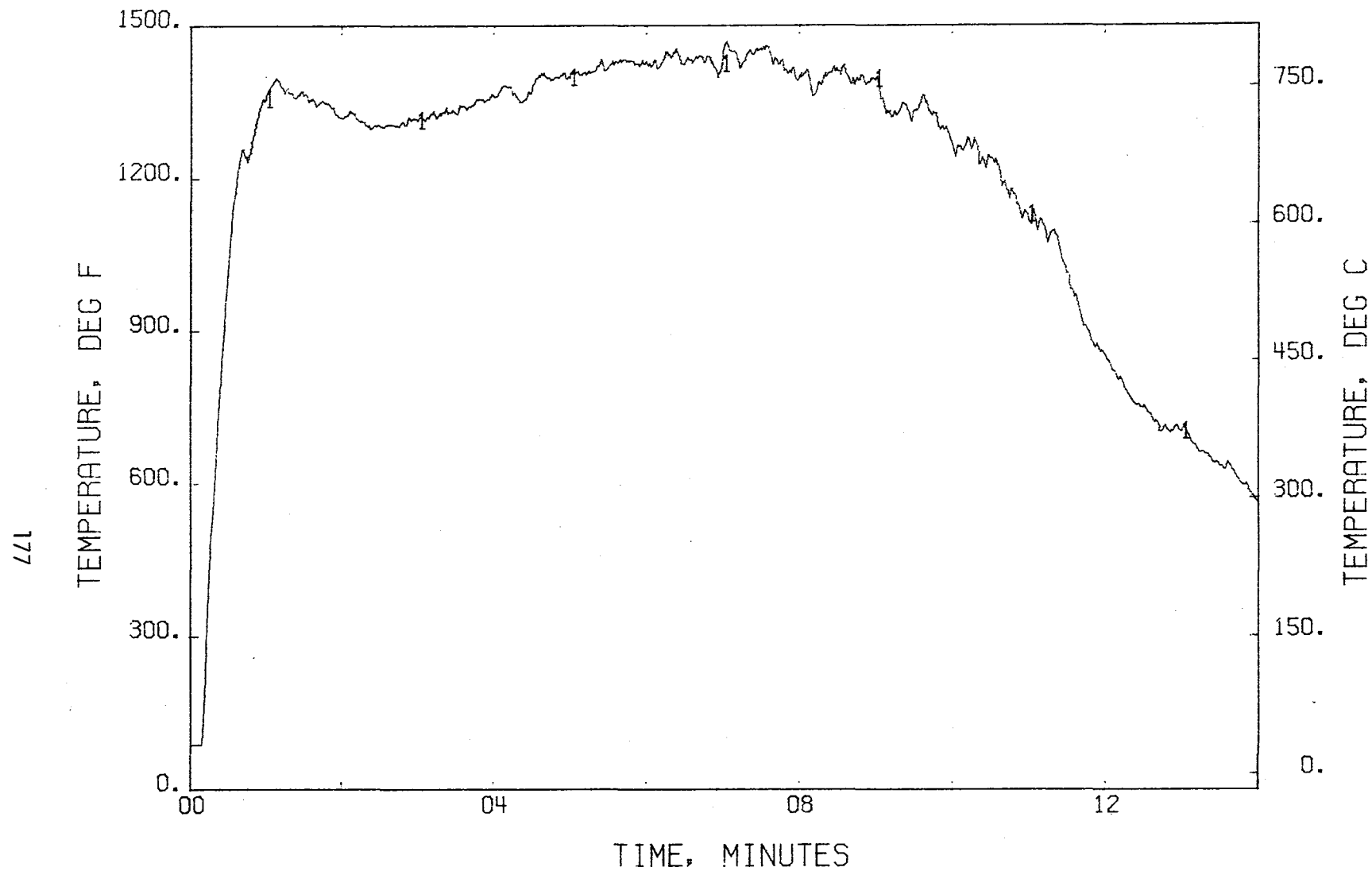


FIGURE 119 . - TEMPERATURE, ABOVE FUEL PAN  
TEST 6

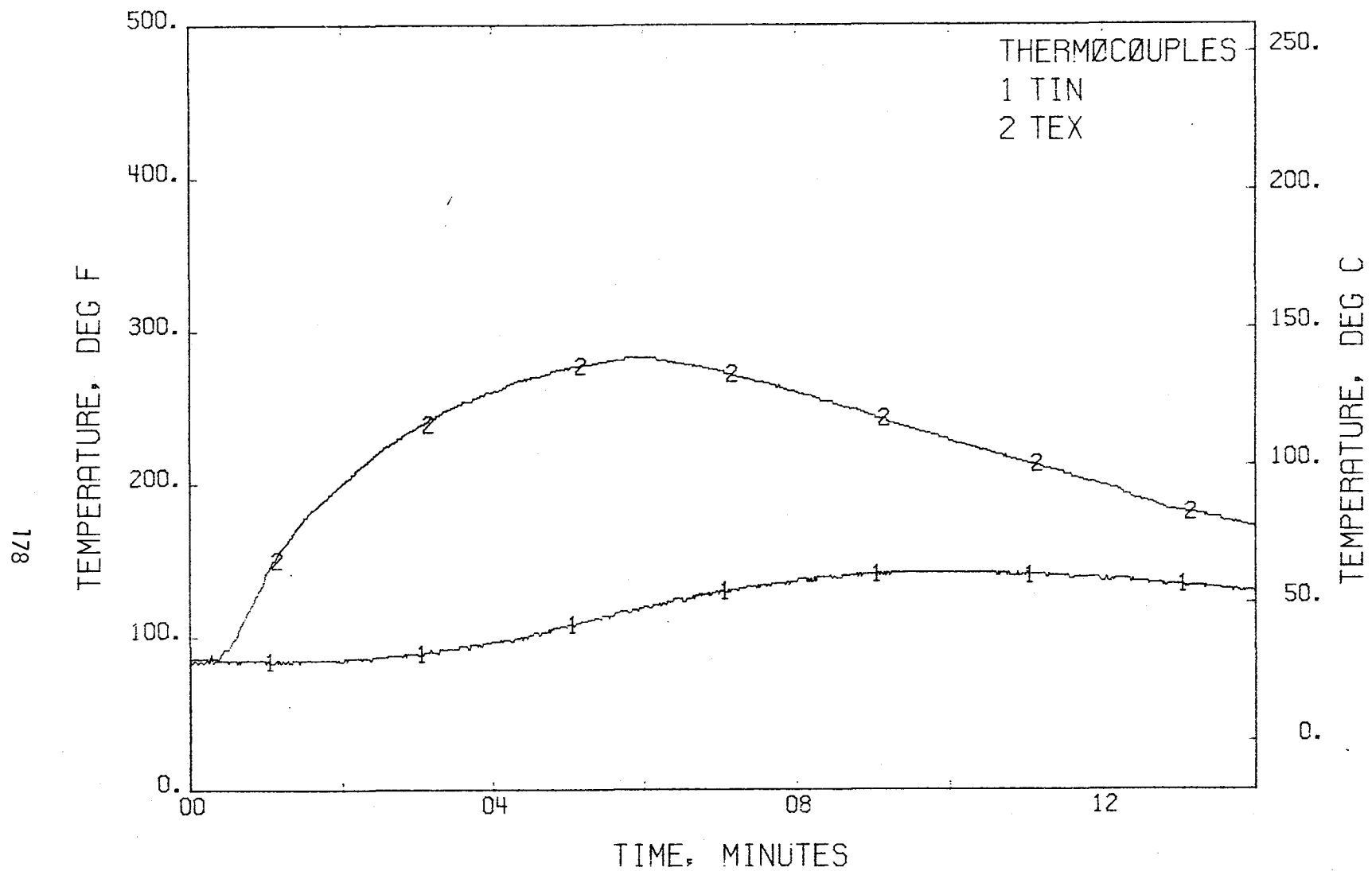


FIGURE 120 . - TEMPERATURES, INLET + EXIT  
TEST 6

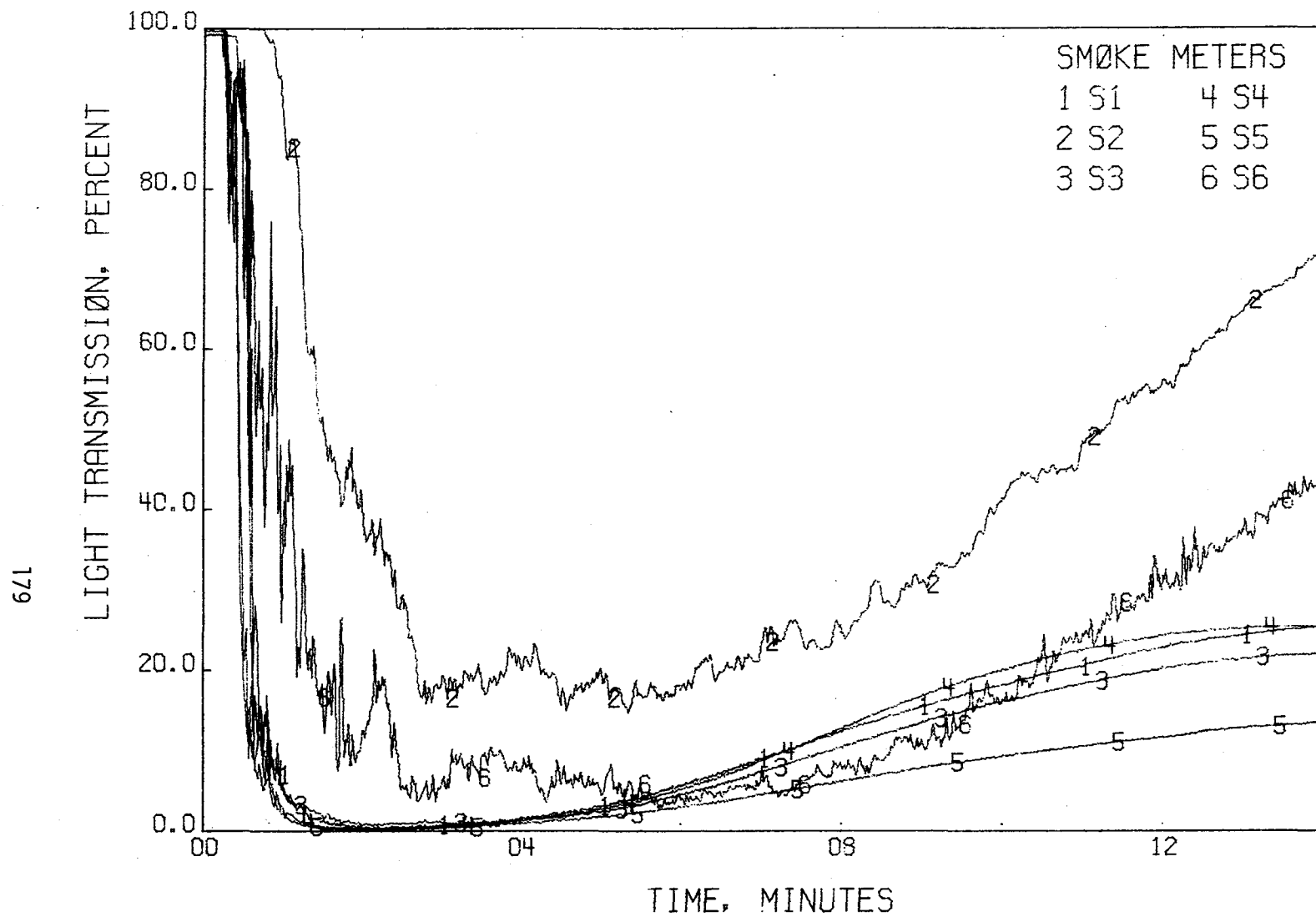


FIGURE 121 . - LIGHT TRANSMISSION  
TEST 6

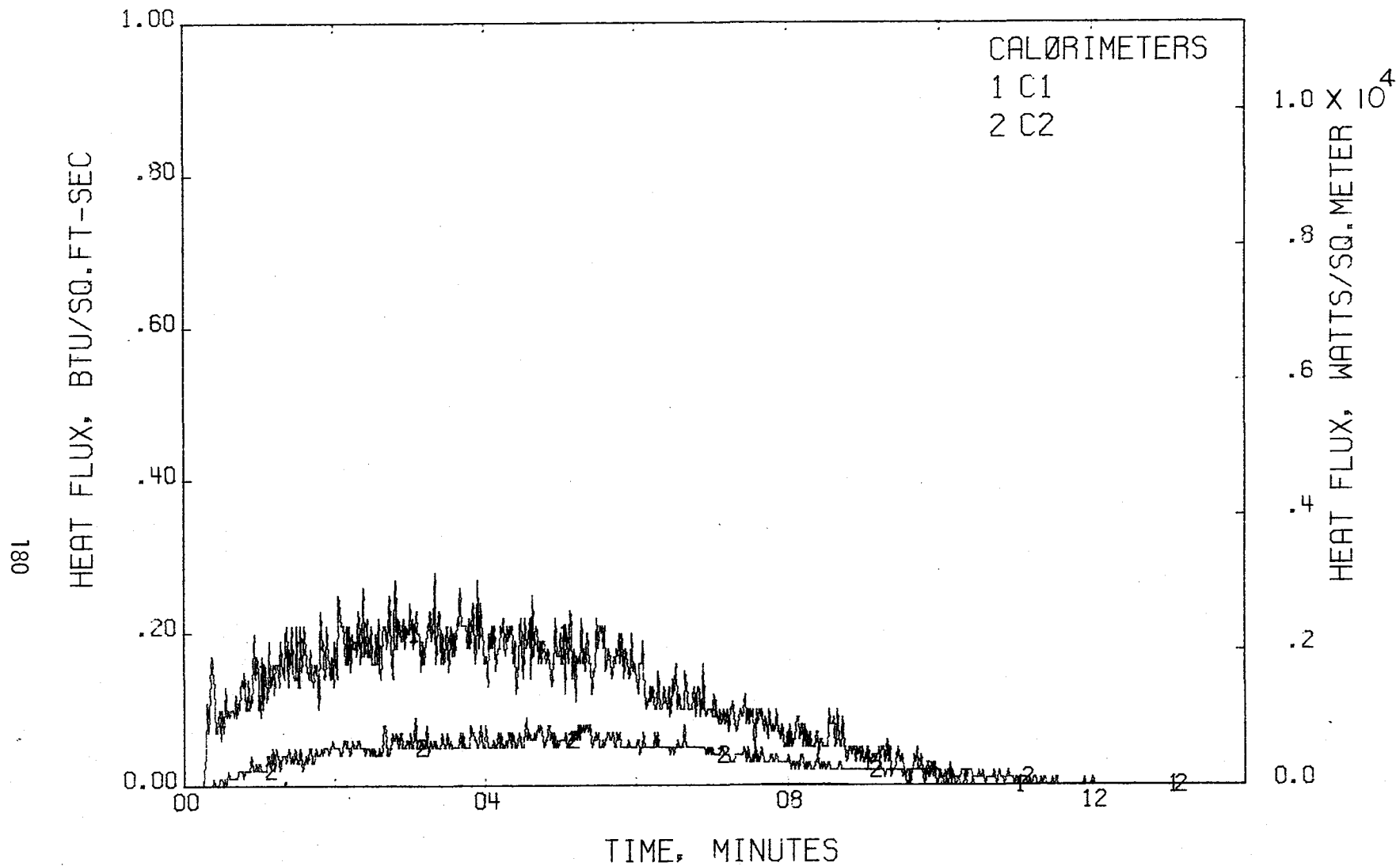


FIGURE 122 . - HEAT FLUX, AFT  
TEST 6

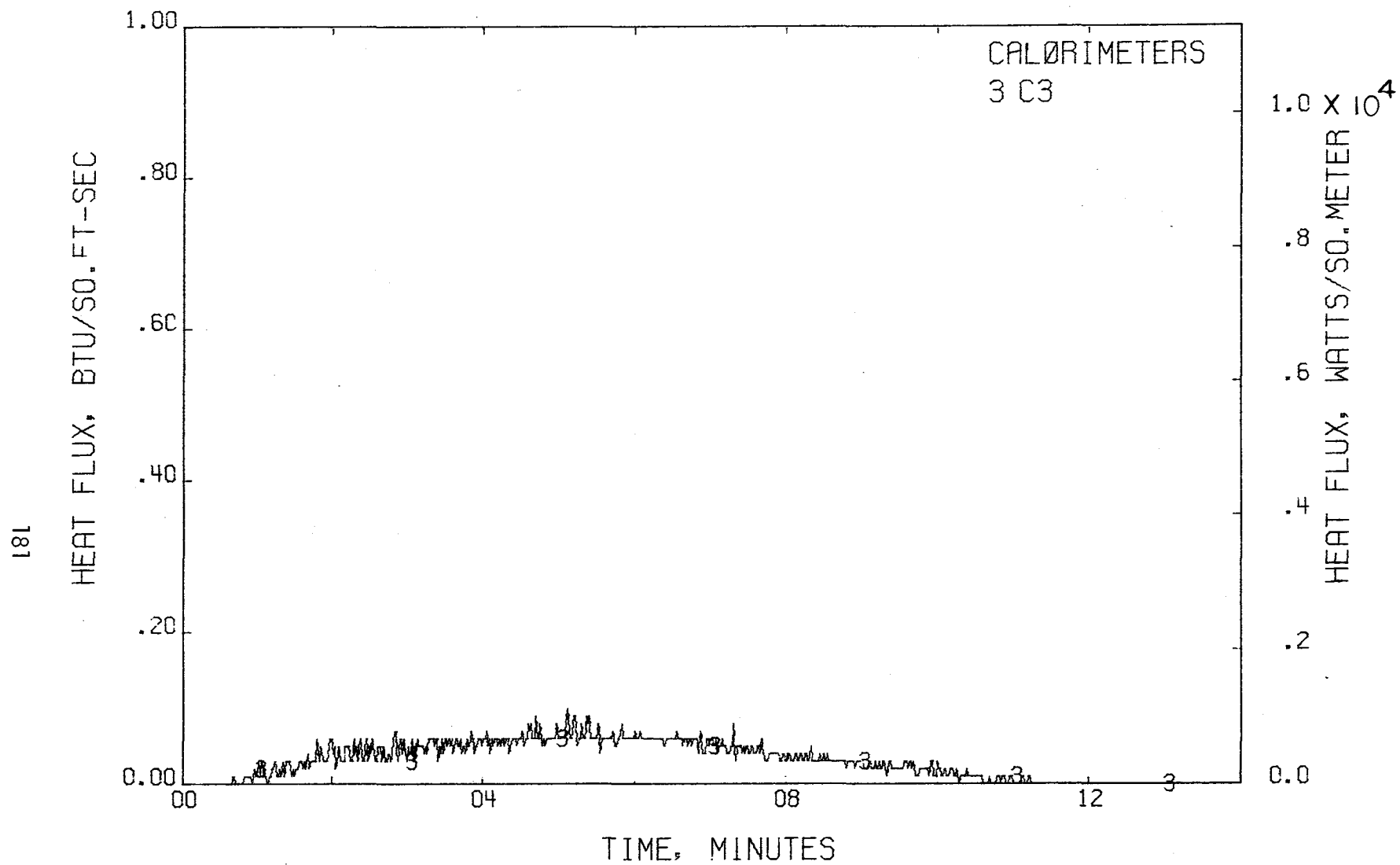
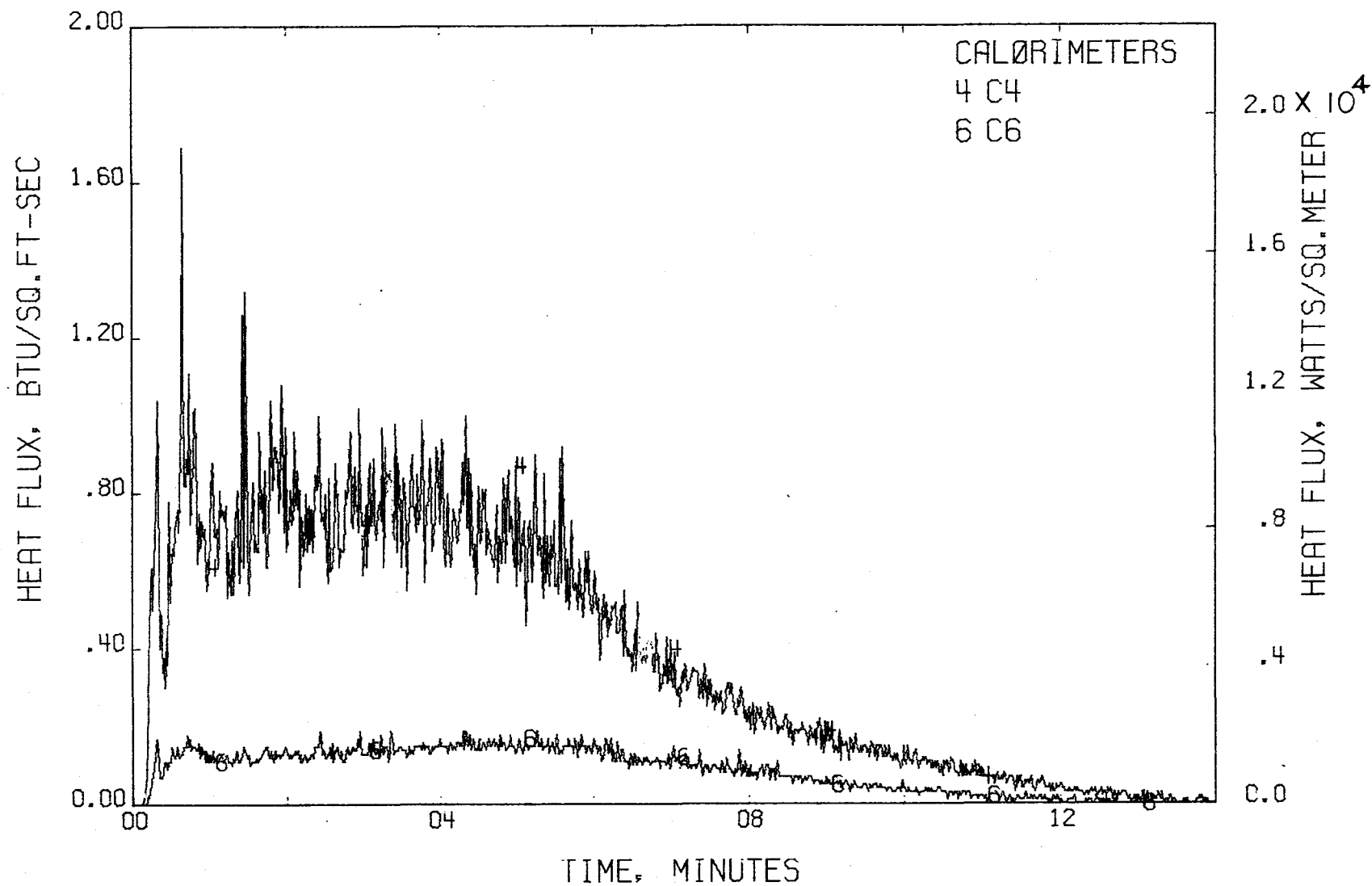


FIGURE 122 . - HEAT FLUX, AFT - CØNTINUED  
TEST 6



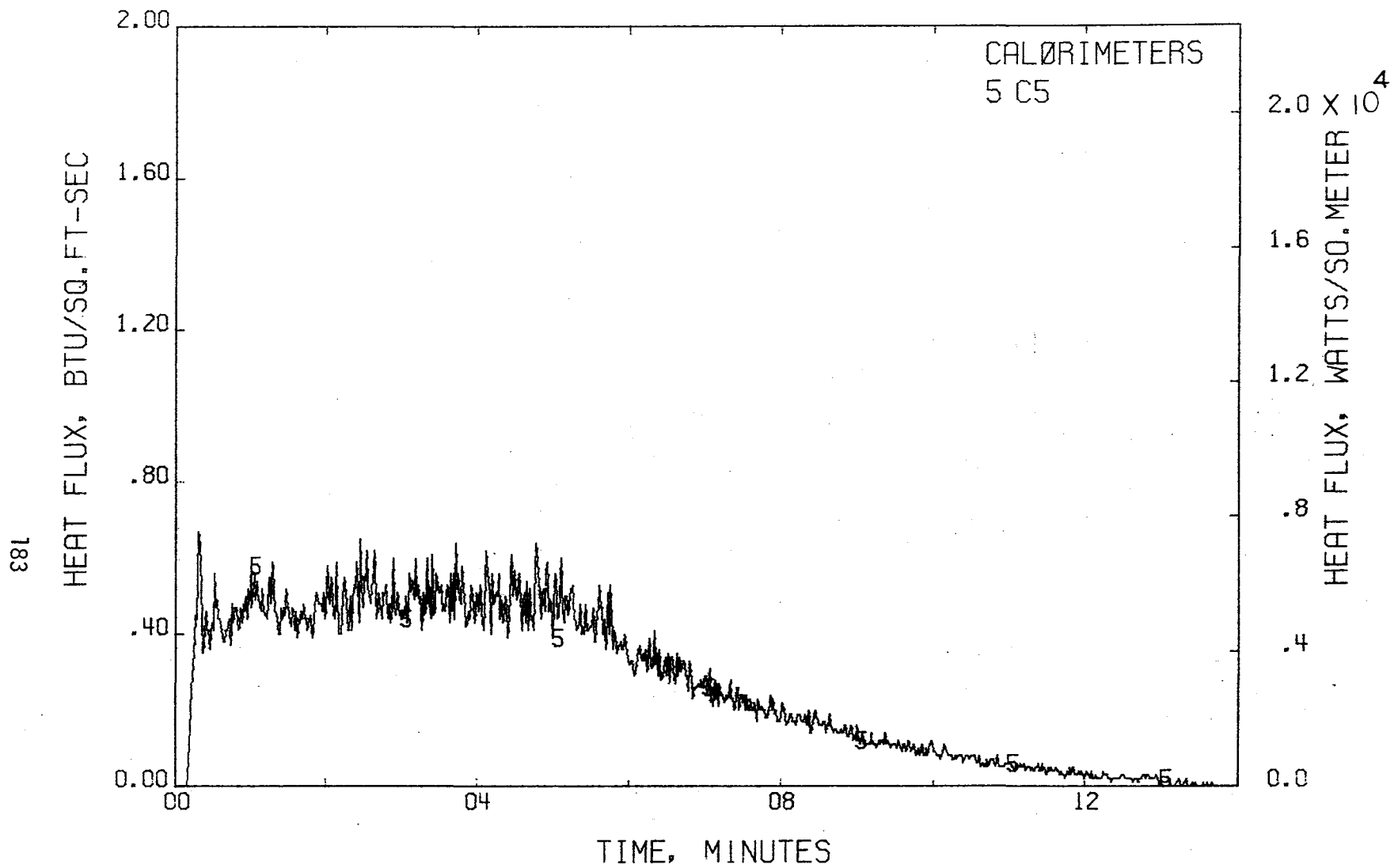


FIGURE 123 . - HEAT FLUX, MIDSECTION - CØNTINUED  
TEST 6

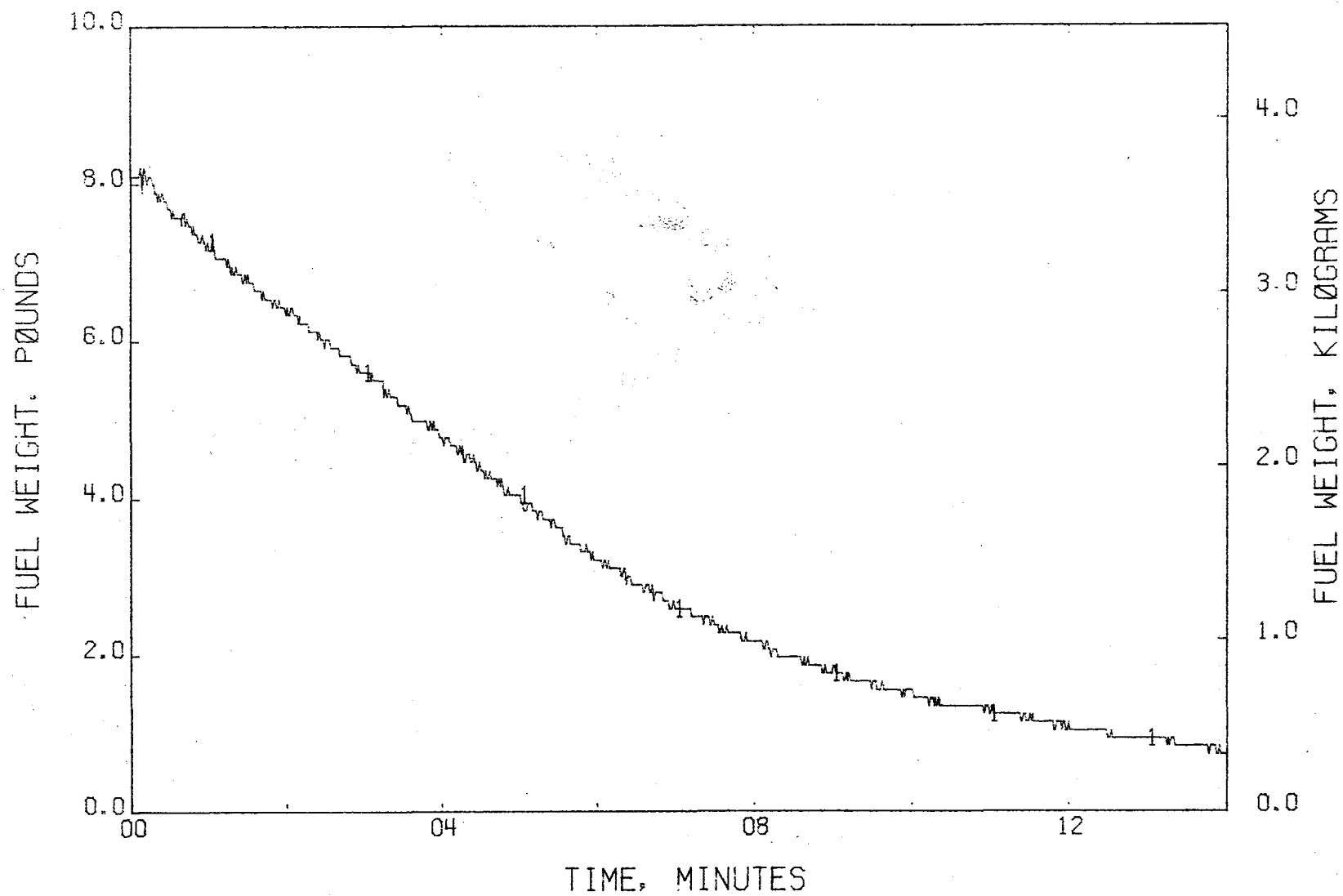


FIGURE 124 . - FUEL WEIGHT LOSS  
TEST 6



THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - <12 PPM

HYDROGEN FLUORIDE - <12 PPM

HYDROGEN CHLORIDE - <24 PPM

FIGURE 125 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 6

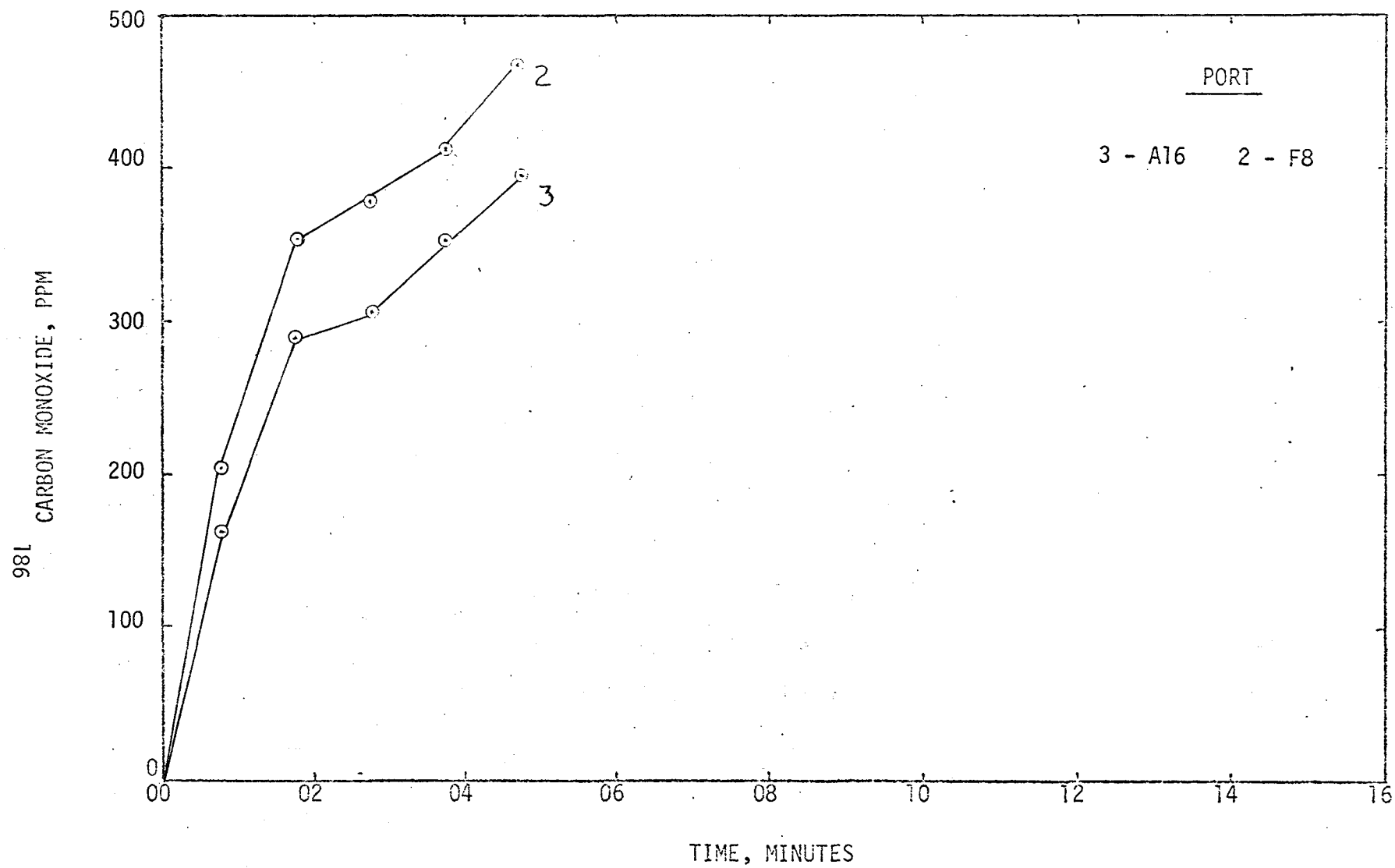


FIGURE 126 . - CARBON MONOXIDE CONCENTRATIONS.  
TEST 6

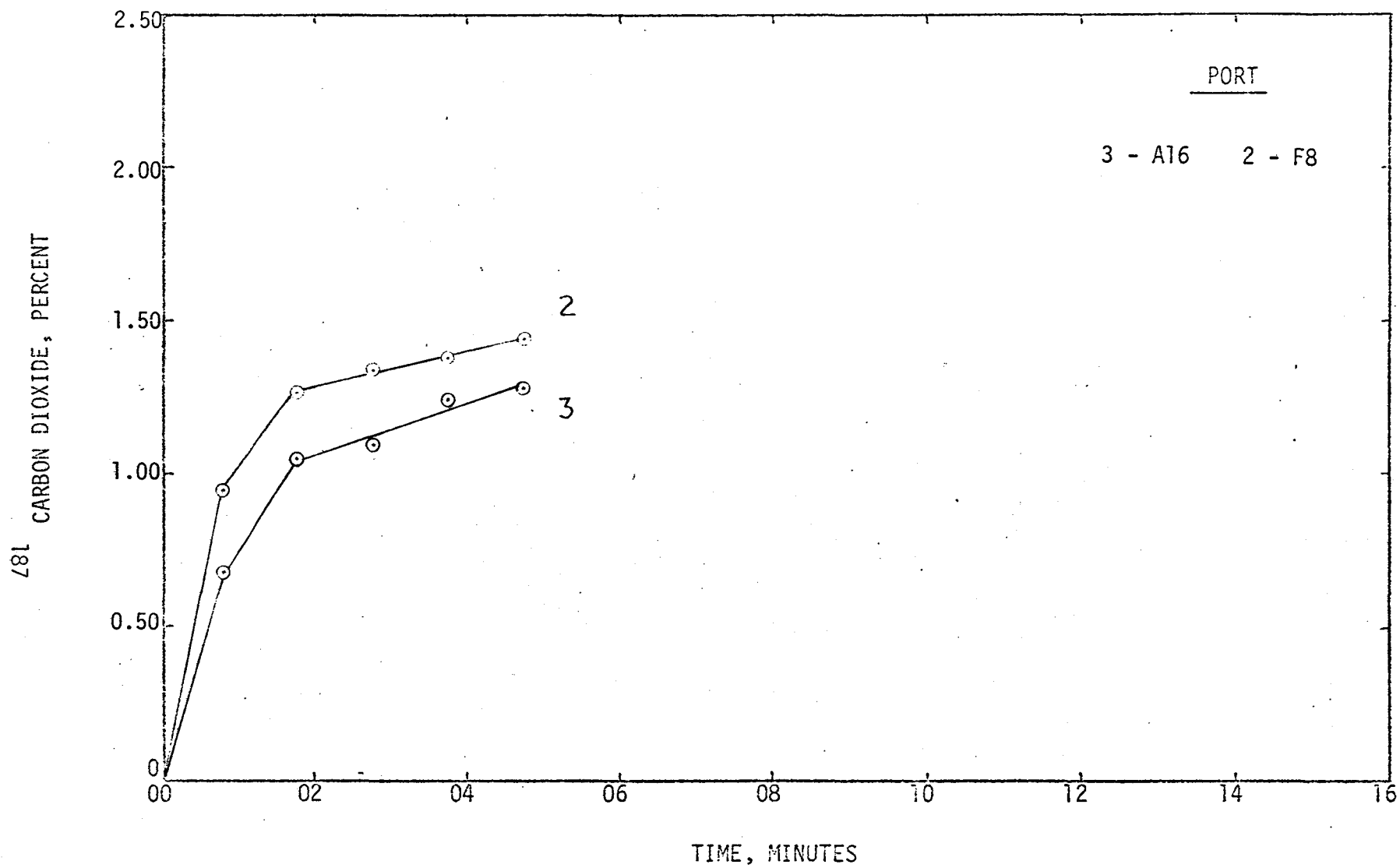


FIGURE 127 . - CARBON DIOXIDE CONCENTRATIONS  
TEST 6

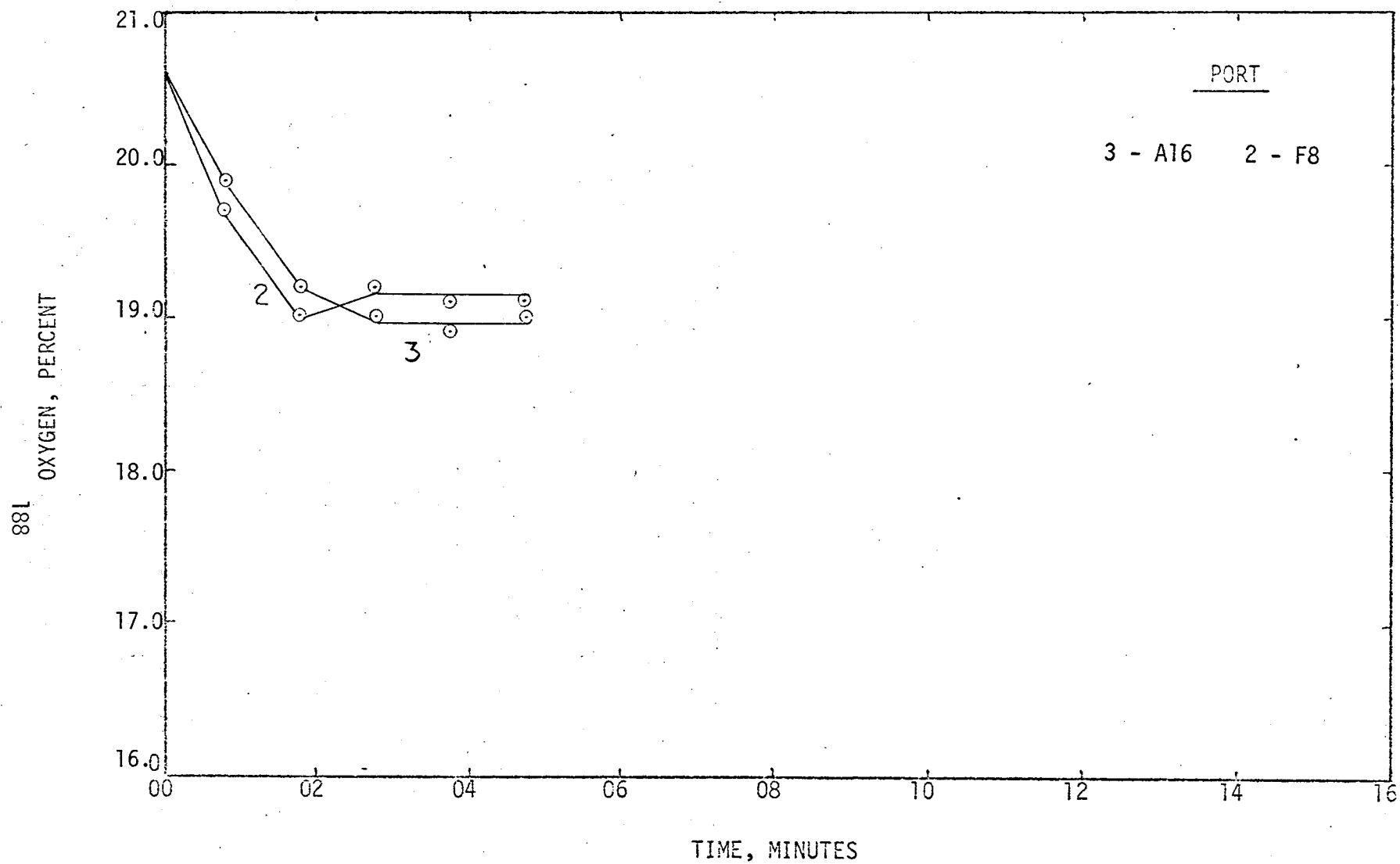


FIGURE 128 - OXYGEN CONCENTRATIONS

TEST 6

TESTS 7-8-9

These 3 test numbers were not used in this test program.

TEST 10  

---

FUEL ONLY

TEST 10  
FUEL ONLY

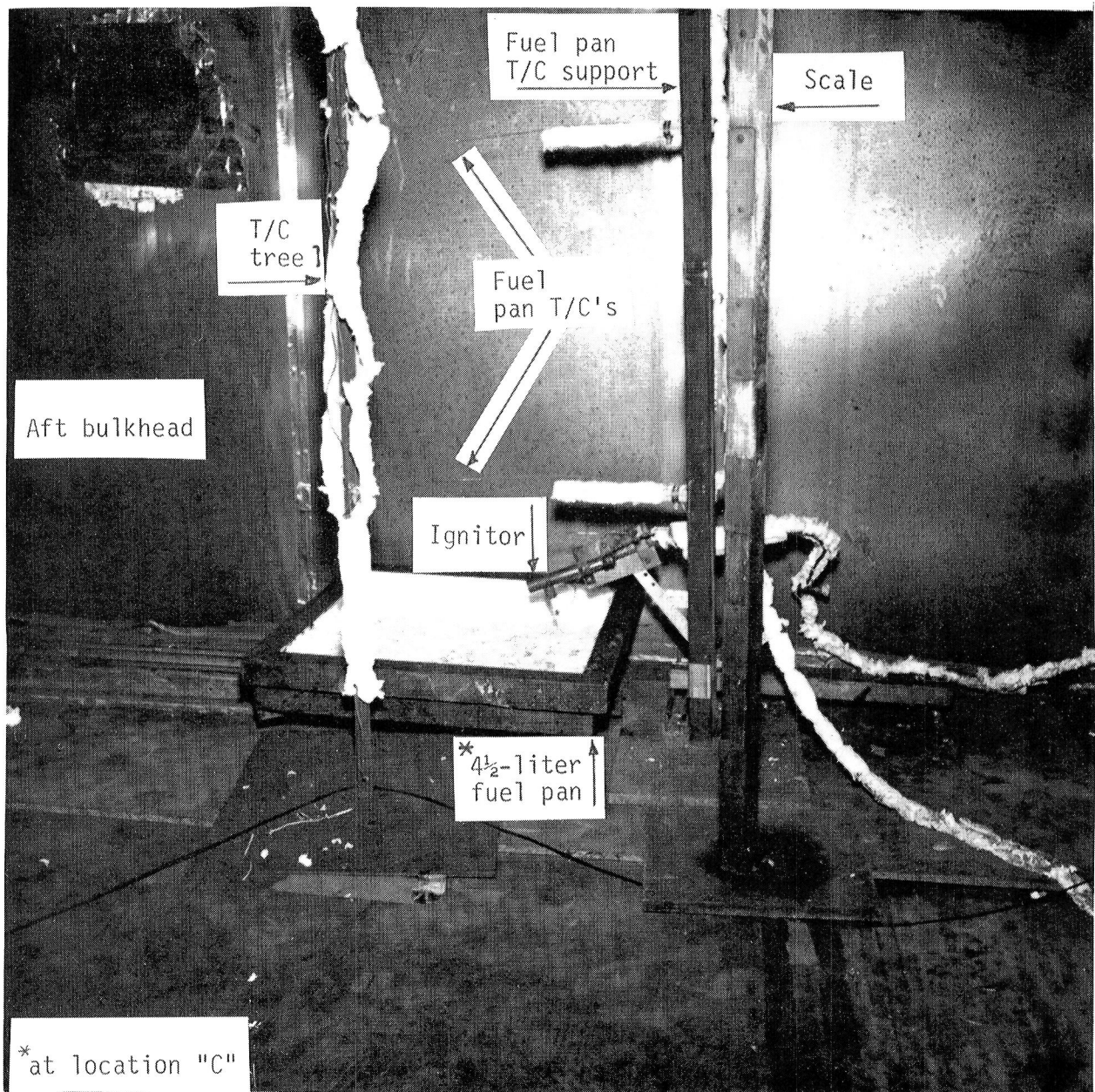


FIGURE 129 - PRE-TEST CONFIGURATION, TEST 10

NO POST-TEST PHOTO WAS TAKEN FOR TEST 10





FIGURE 130 . - FIRE DURING TEST 10

MOST OF THE DATA FOR TEST 10 WAS NOT AVAILABLE,  
WITH THE EXCEPTION OF THE GAS ANALYSIS DATA.

NON-AVAILABLE DATA

TEST 10

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST

ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 6 PPM

HYDROGEN FLUORIDE - < 6 PPM

HYDROGEN CHLORIDE - < 12 PPM

FIGURE 131 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 10

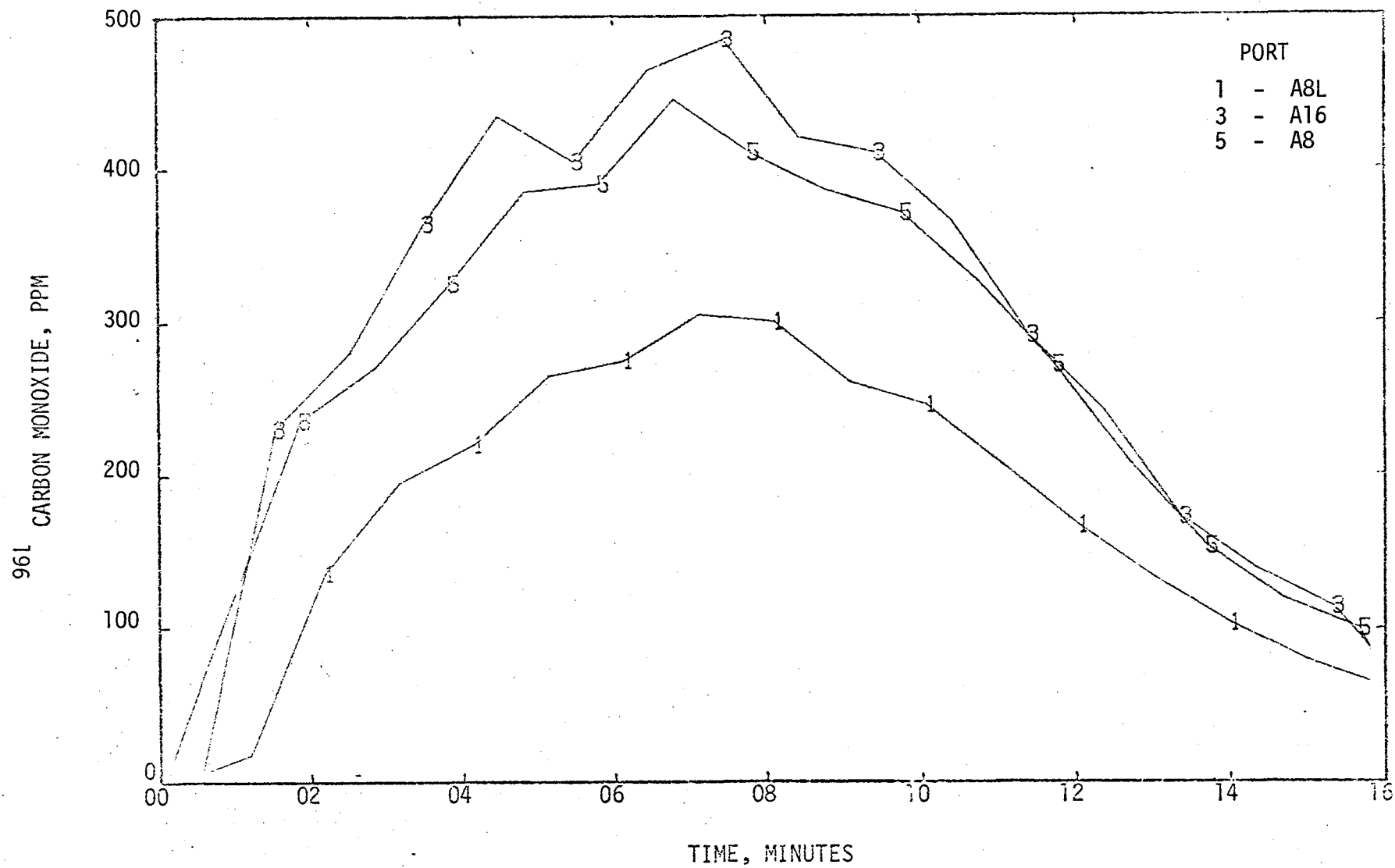


FIGURE 132 - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 10

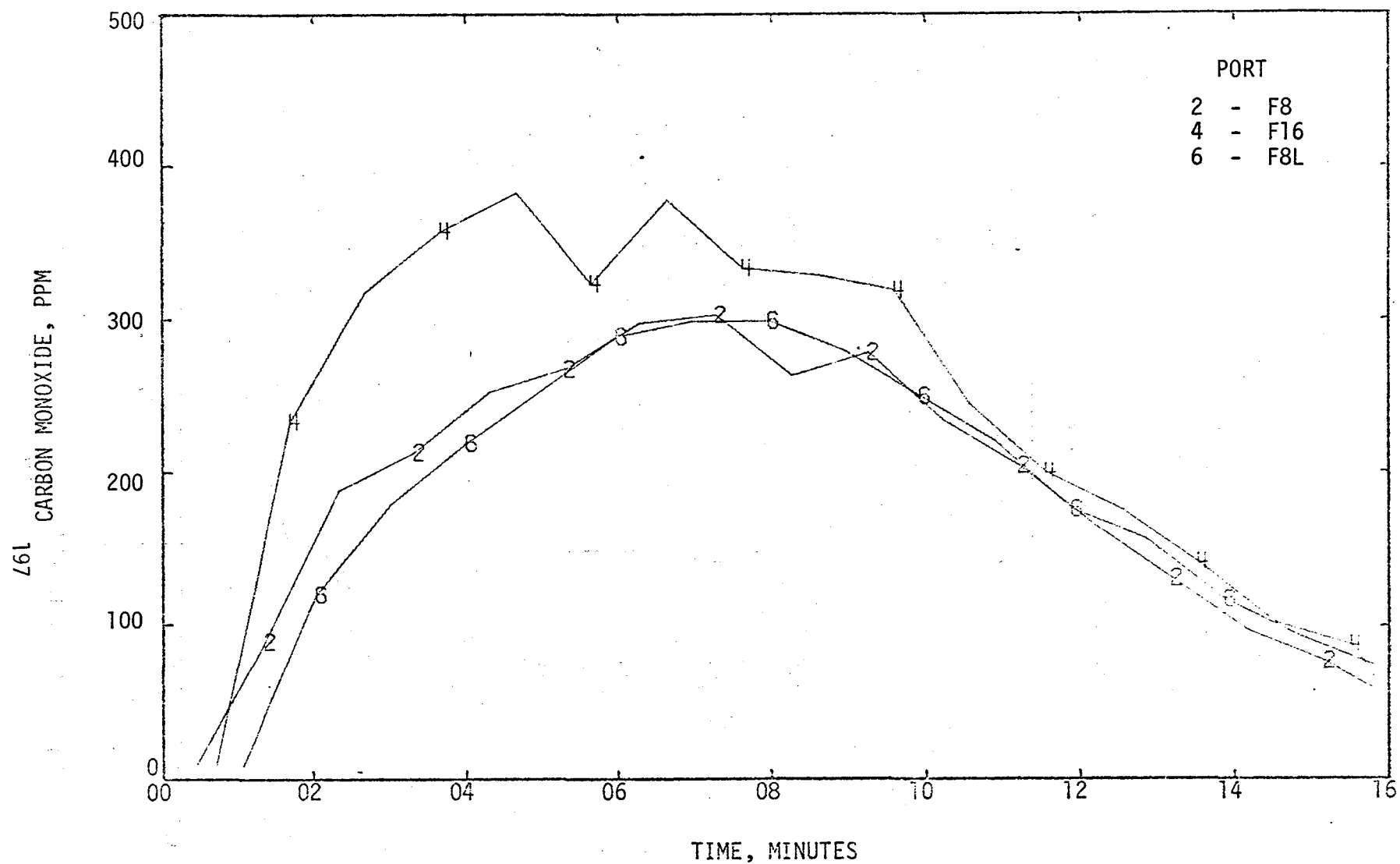


FIGURE 133 - CARBON MONOXIDE CONCENTRATIONS, FORE  
TEST 10

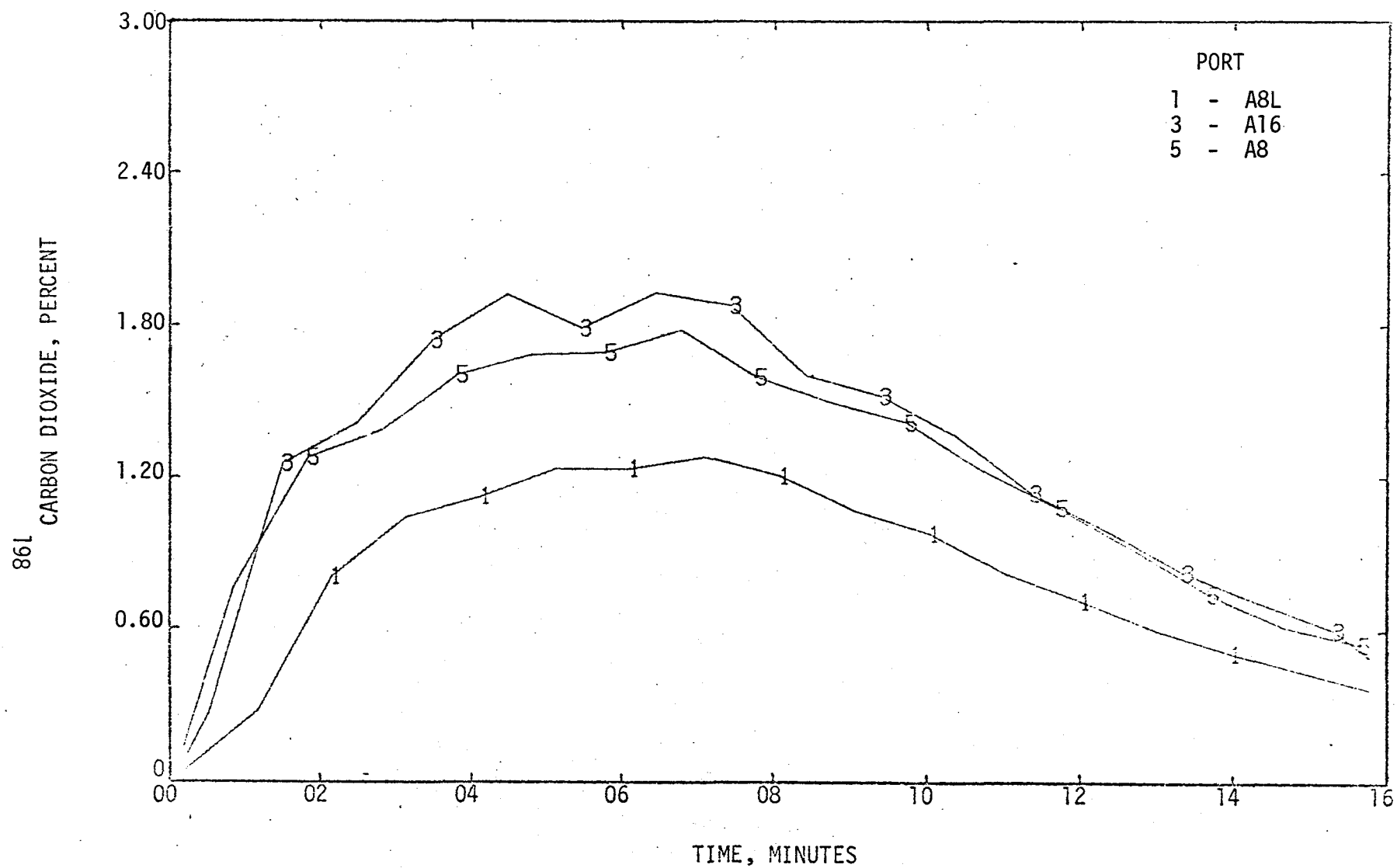


FIGURE 134 . - CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 10

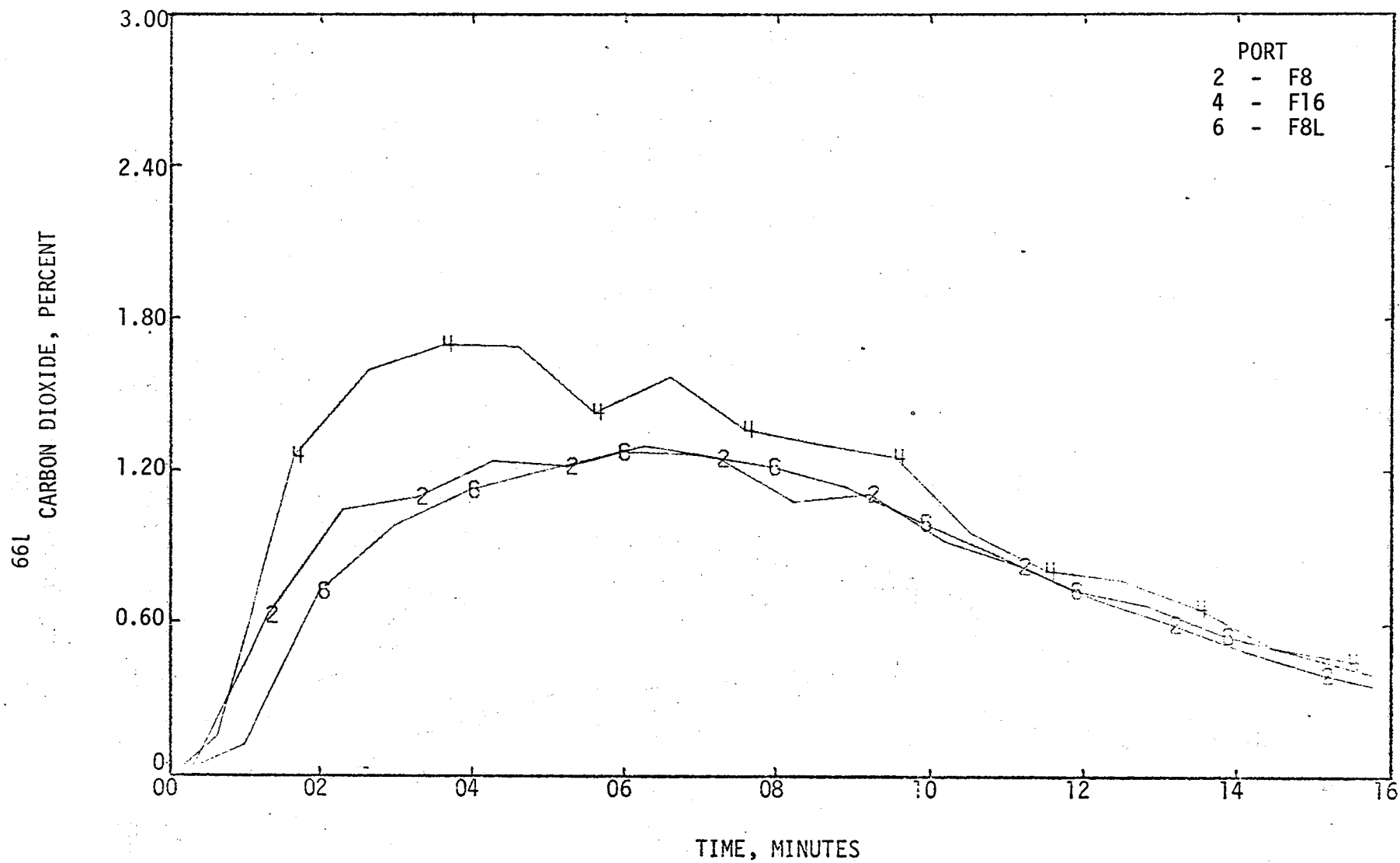


FIGURE 135 . - CARBON DIOXIDE CONCENTRATIONS, FORE  
TEST 10

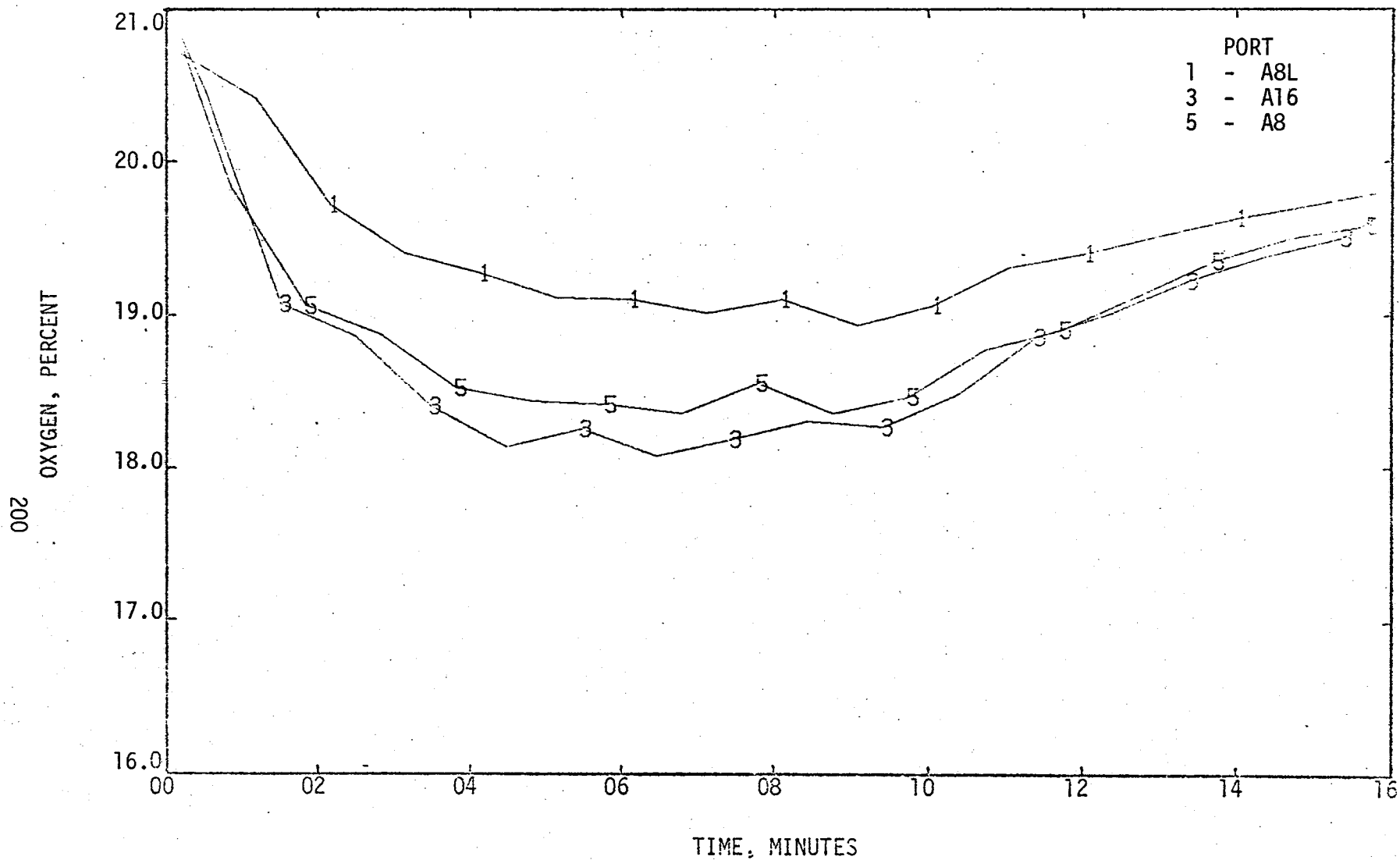


FIGURE 136 . - OXYGEN CONCENTRATIONS, AFT  
TEST 10



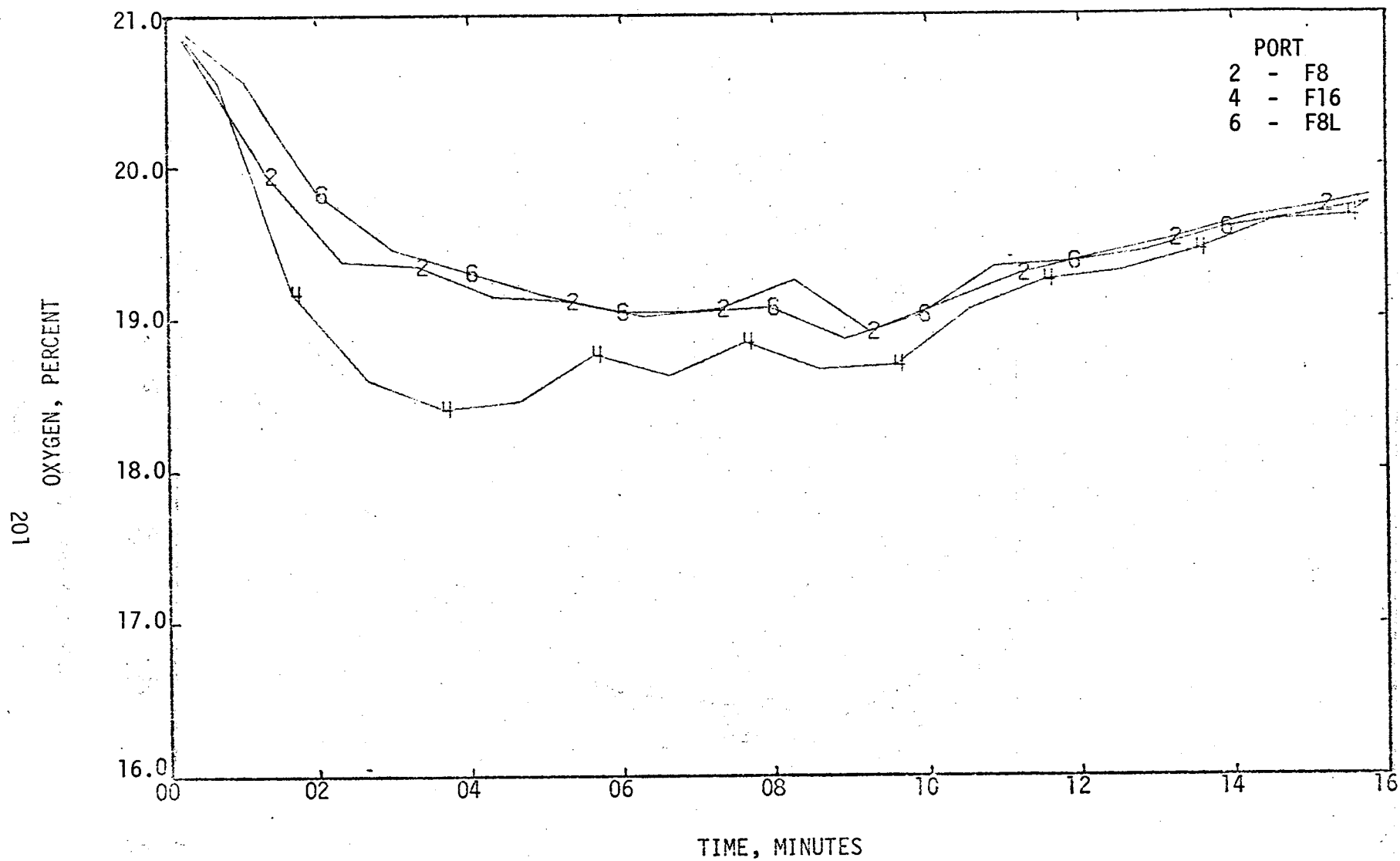


FIGURE 137 , - OXYGEN CONCENTRATIONS, FORE  
TEST 10

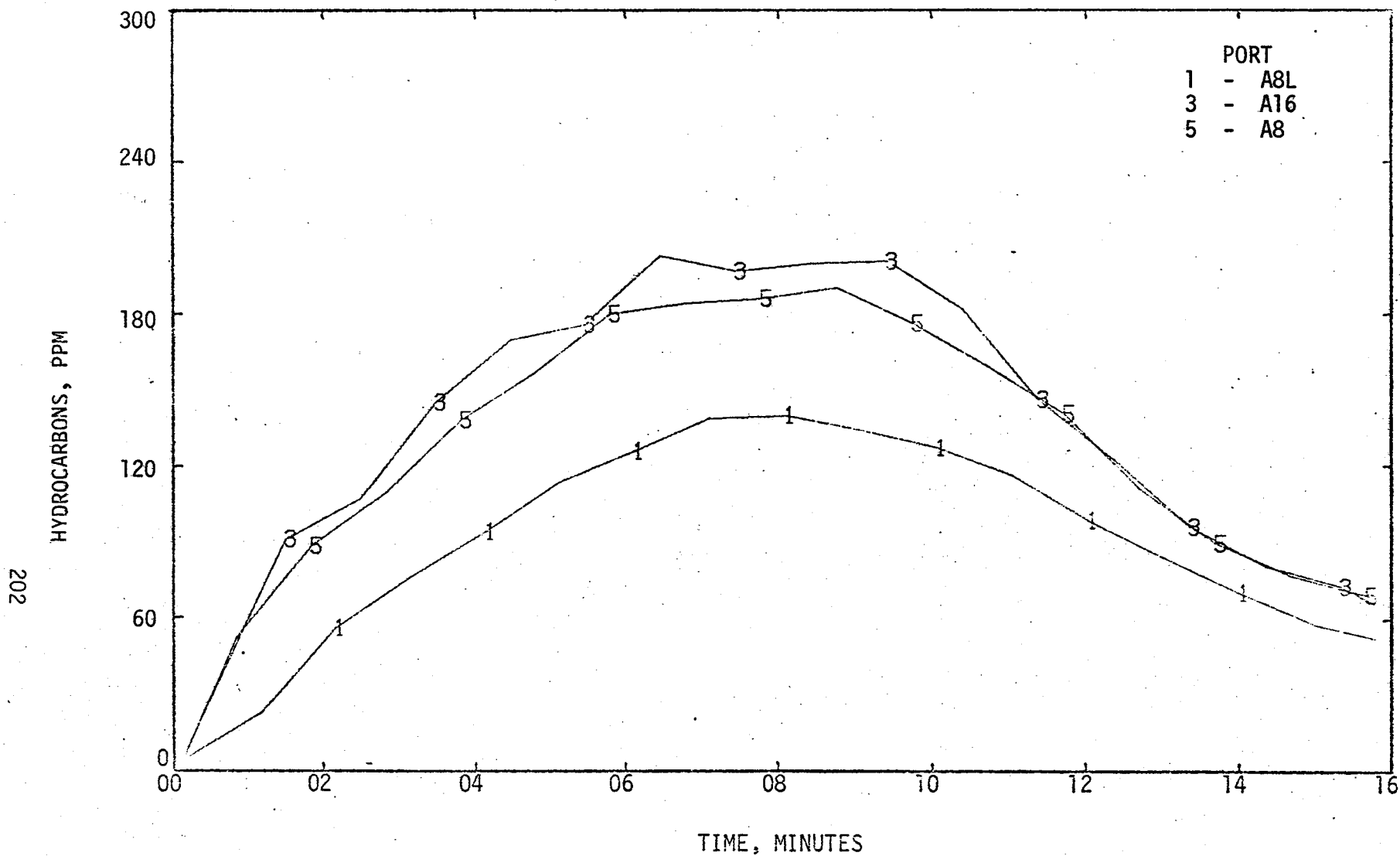


FIGURE 138 - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 10

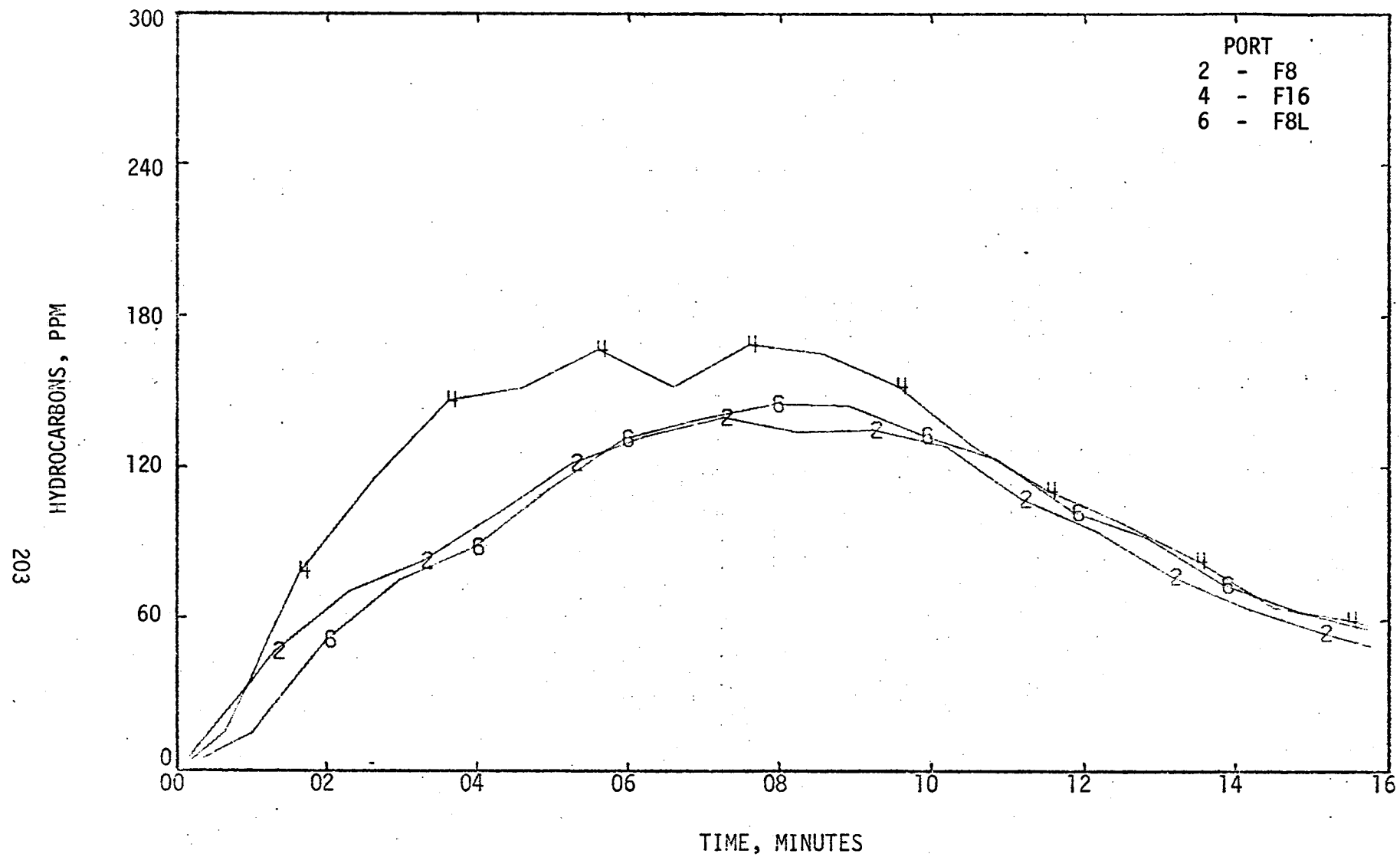


FIGURE 139 - HYDROCARBONS CONCENTRATIONS, FORE  
TEST 10

TEST 11  
FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 11

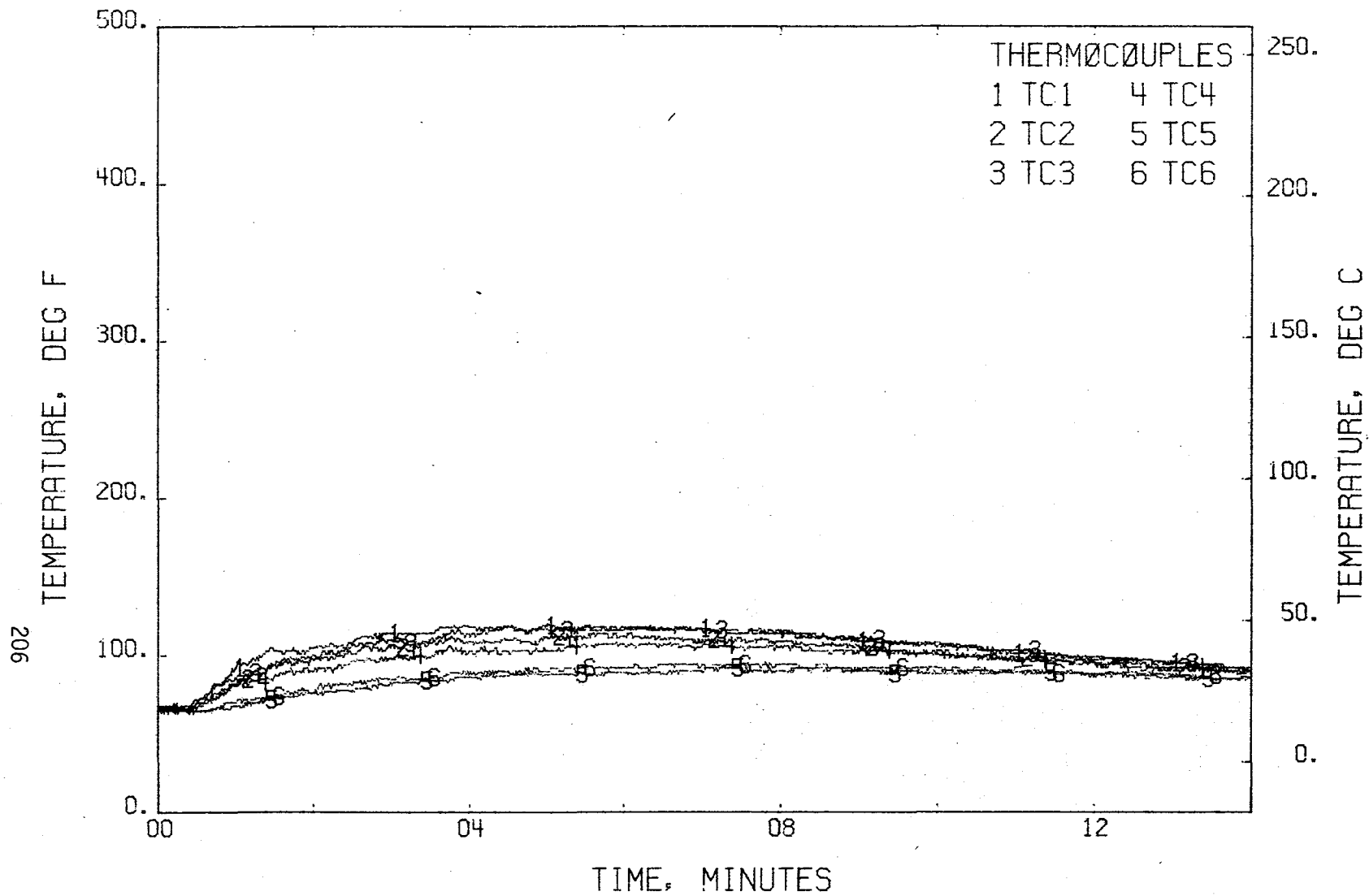


FIGURE 140 . - TEMPERATURES, T/C TREE 1  
TEST 11

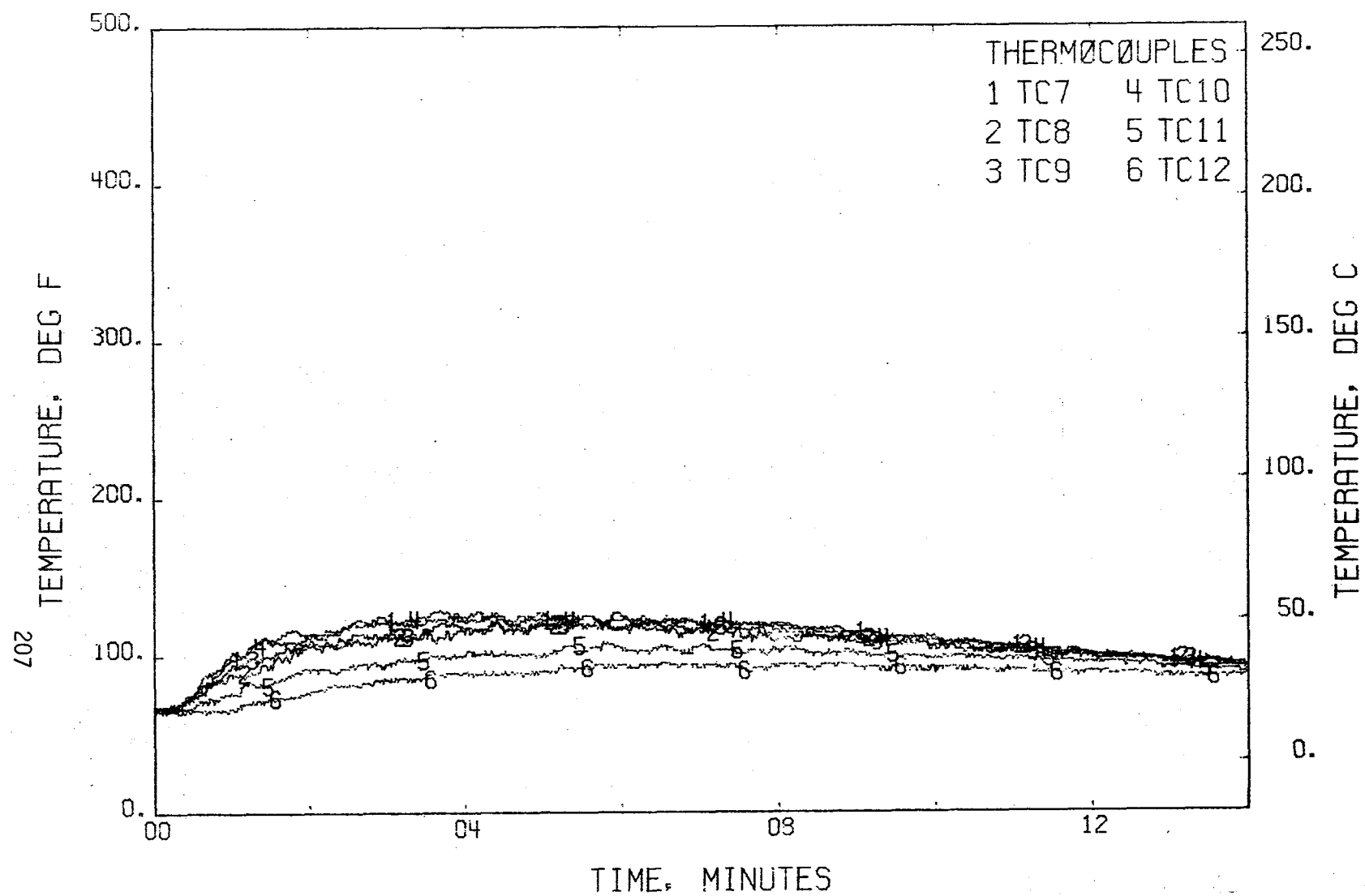


FIGURE 141 . - TEMPERATURES, T/C TREE 2  
TEST 11

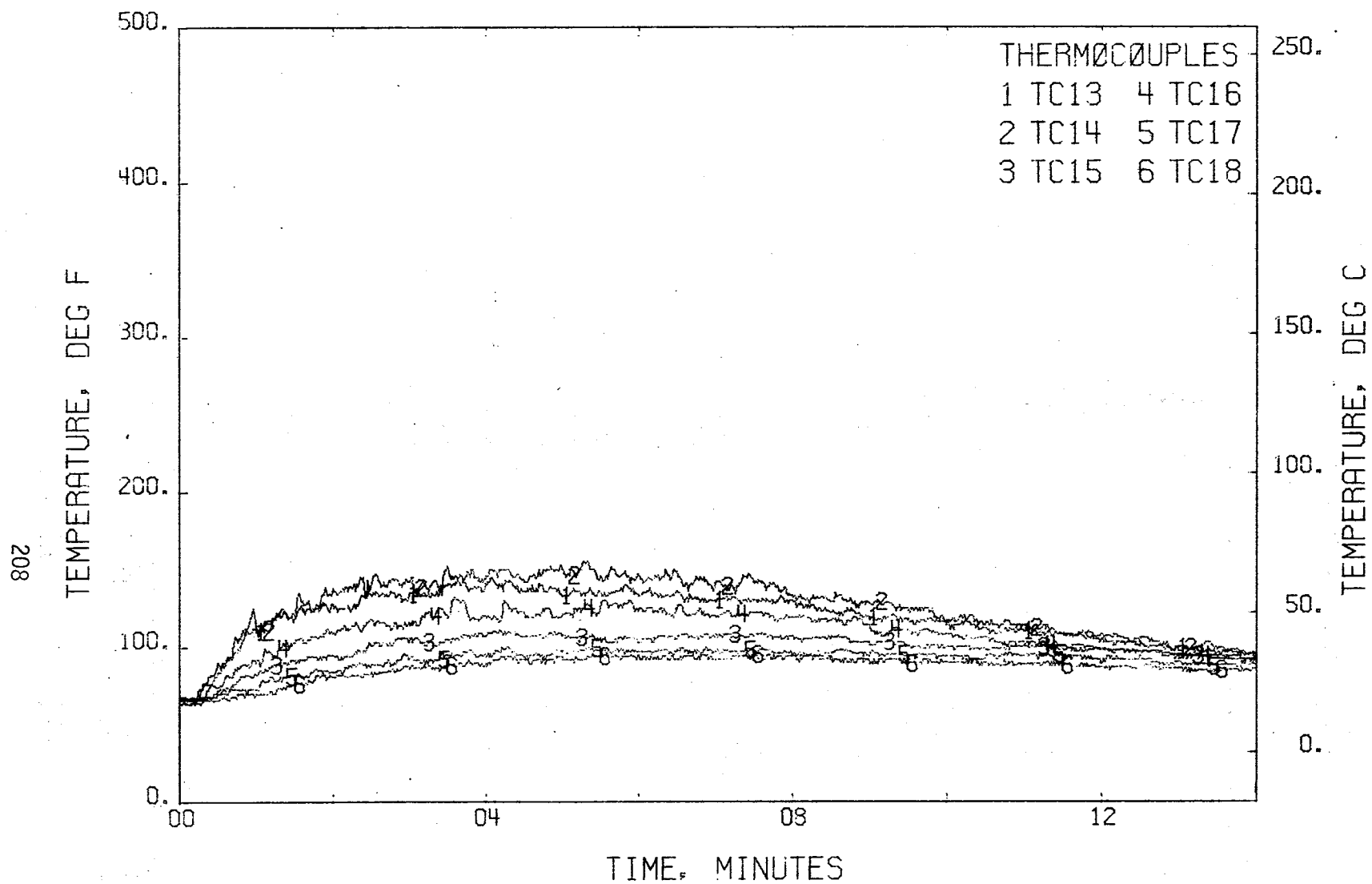


FIGURE 142 . - TEMPERATURES, T/C TREE 3  
TEST 11



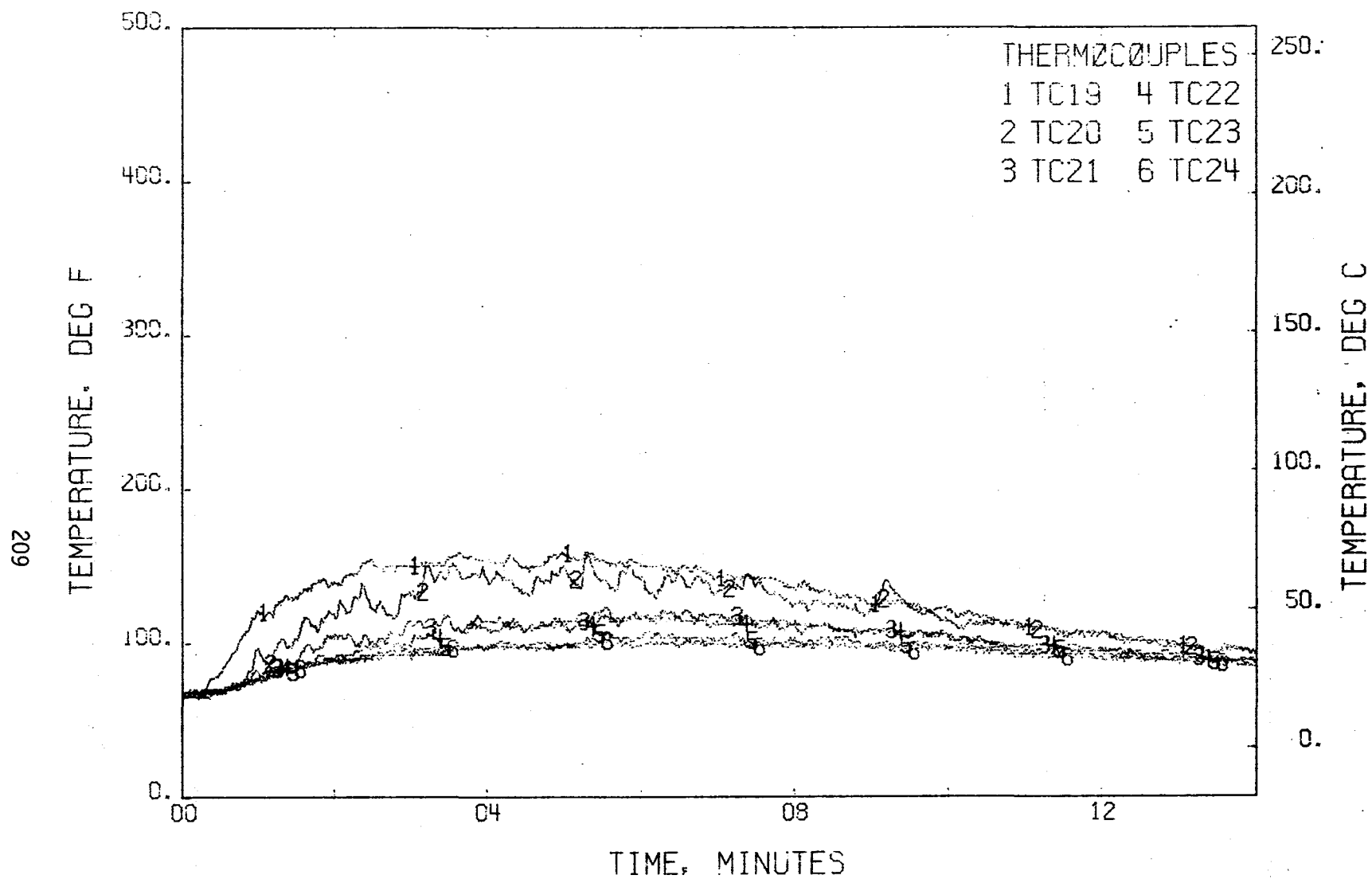


FIGURE 143 . - TEMPERATURES, T/C TREE 4  
TEST 11

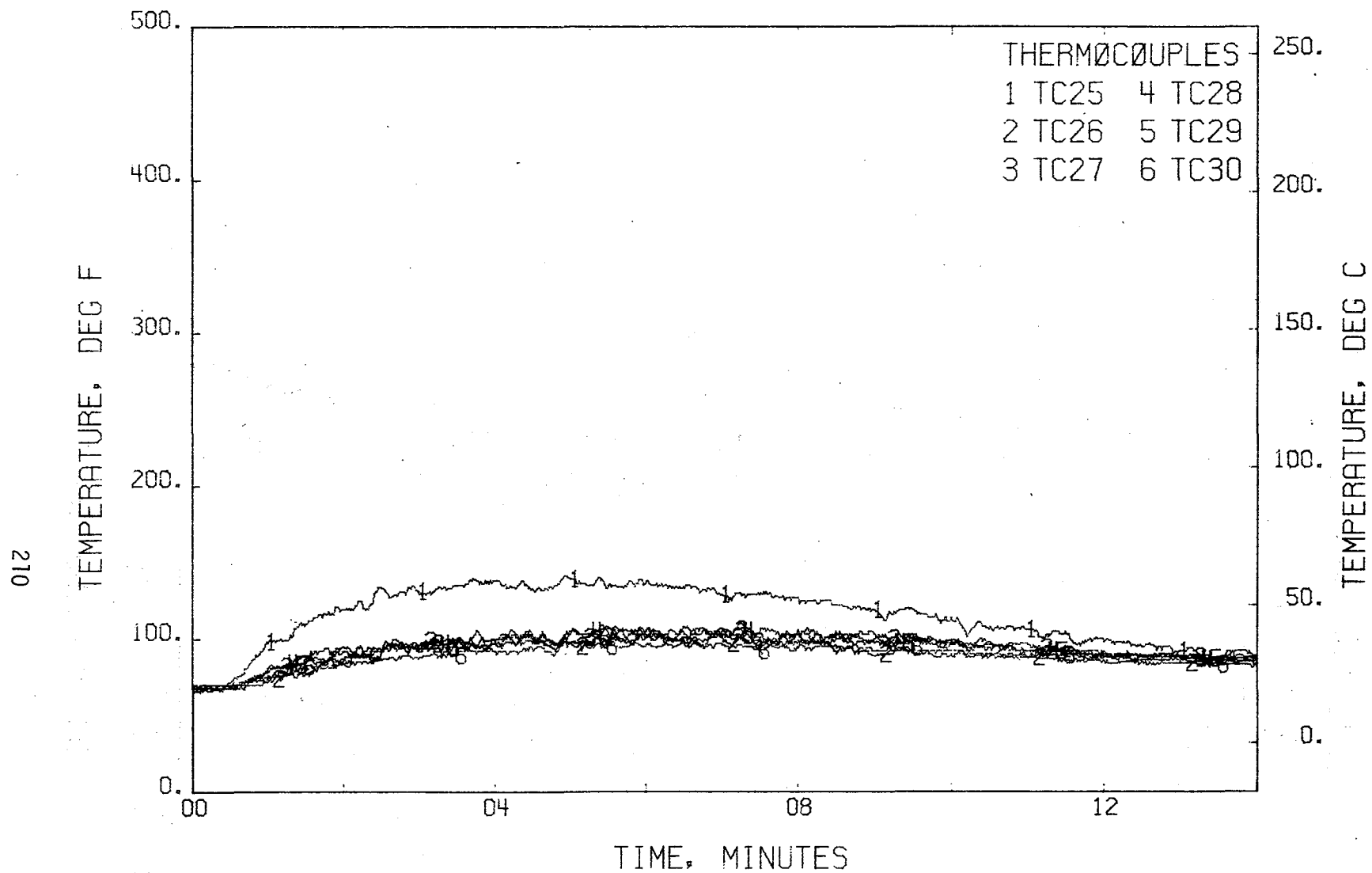


FIGURE 144 . - TEMPERATURES, T/C TREE 5  
TEST 11

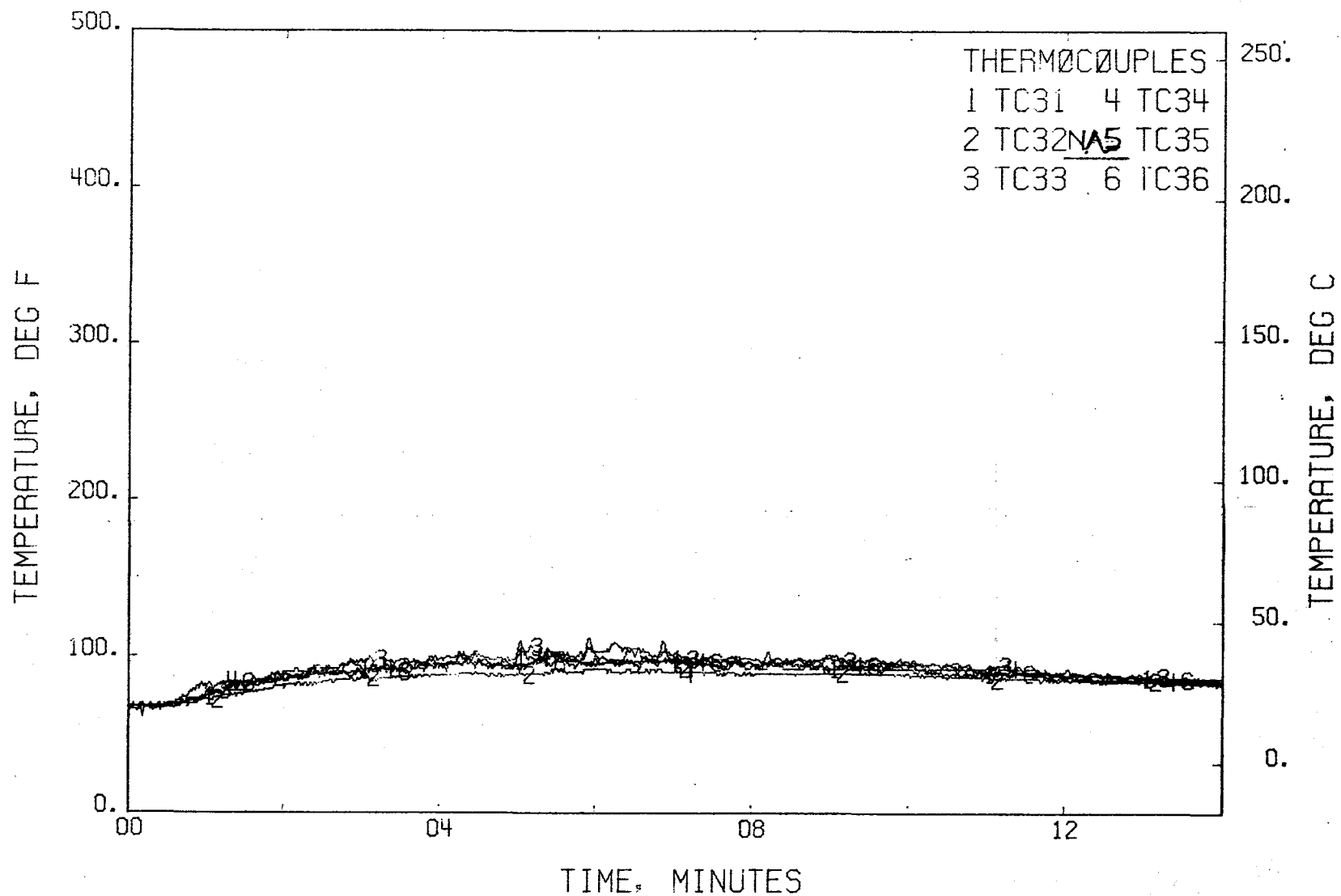


FIGURE 145 . - TEMPERATURES, T/C TREE 6  
TEST 11

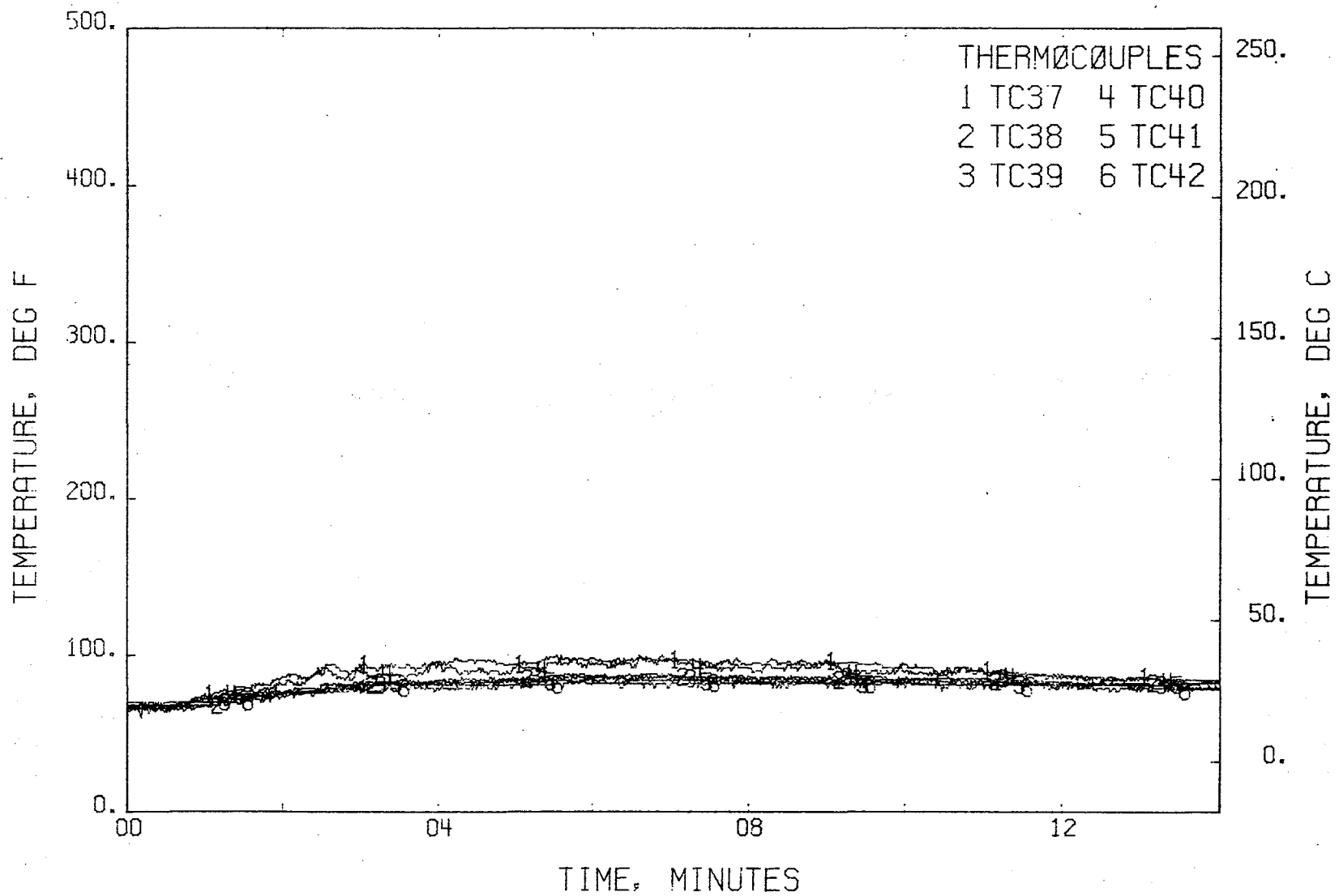


FIGURE 146 . - TEMPERATURES, T/C TREE 7  
TEST 11

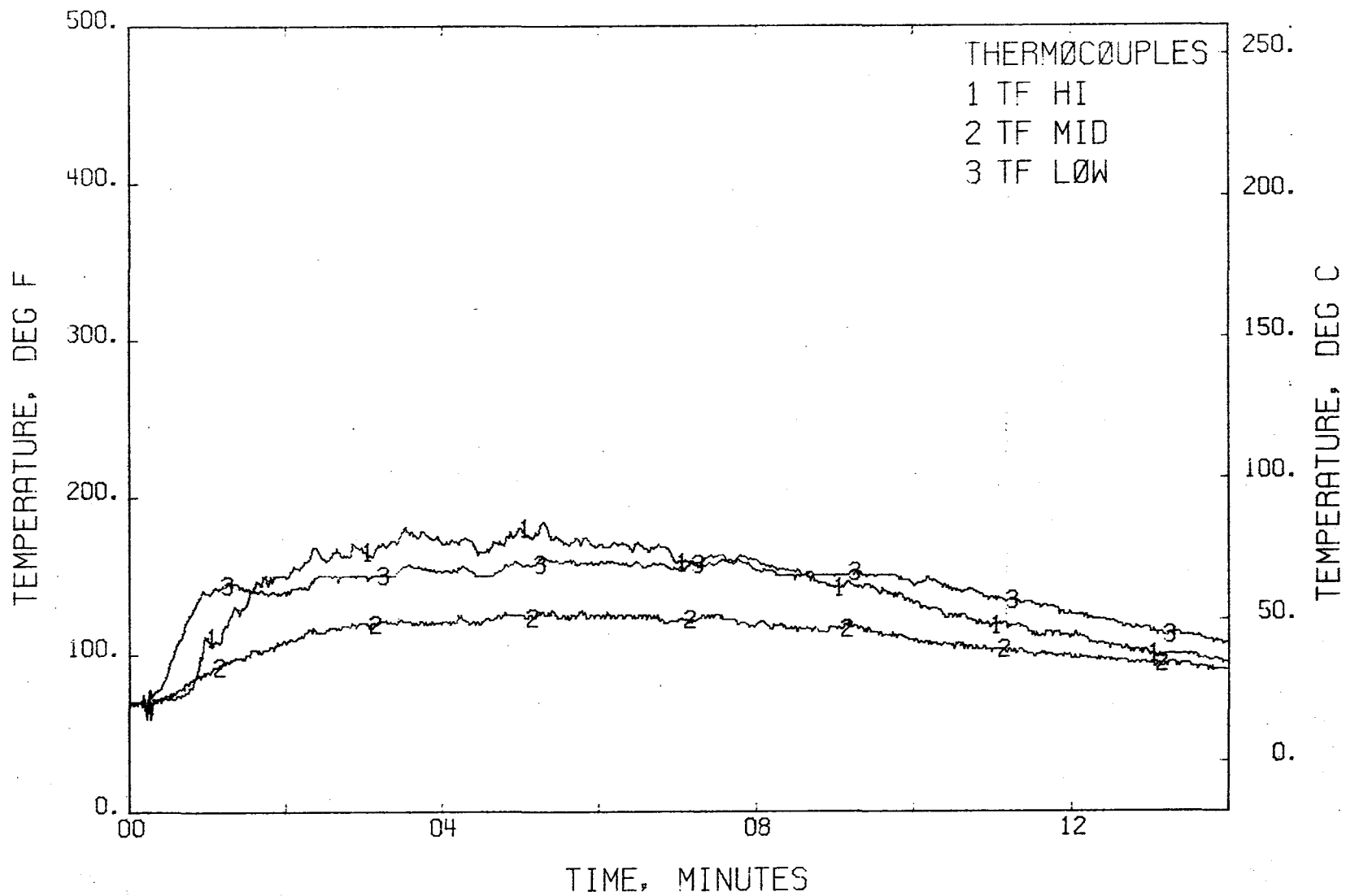


FIGURE 147 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 11

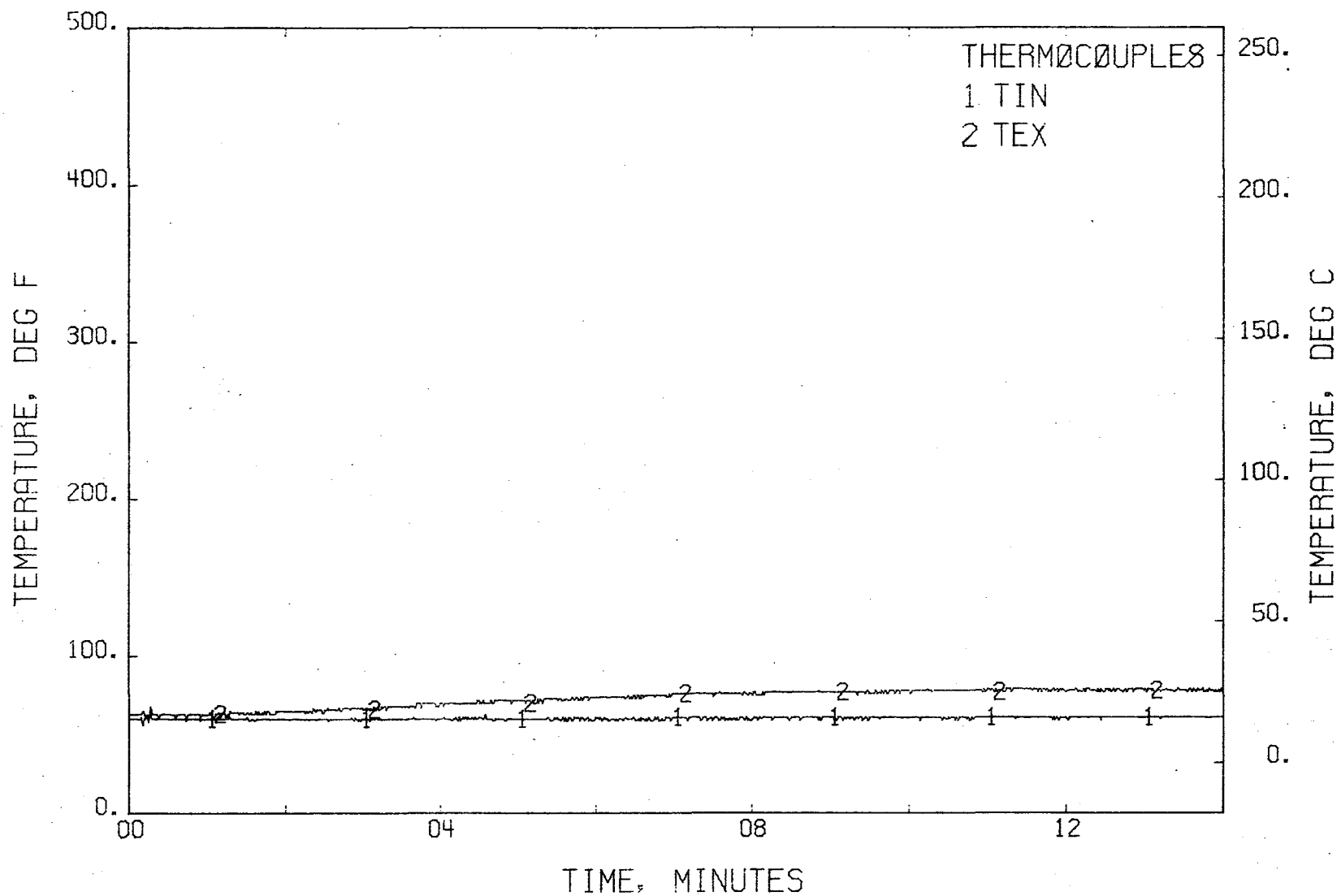


FIGURE 148 . - TEMPERATURES, INLET + EXIT  
TEST 11

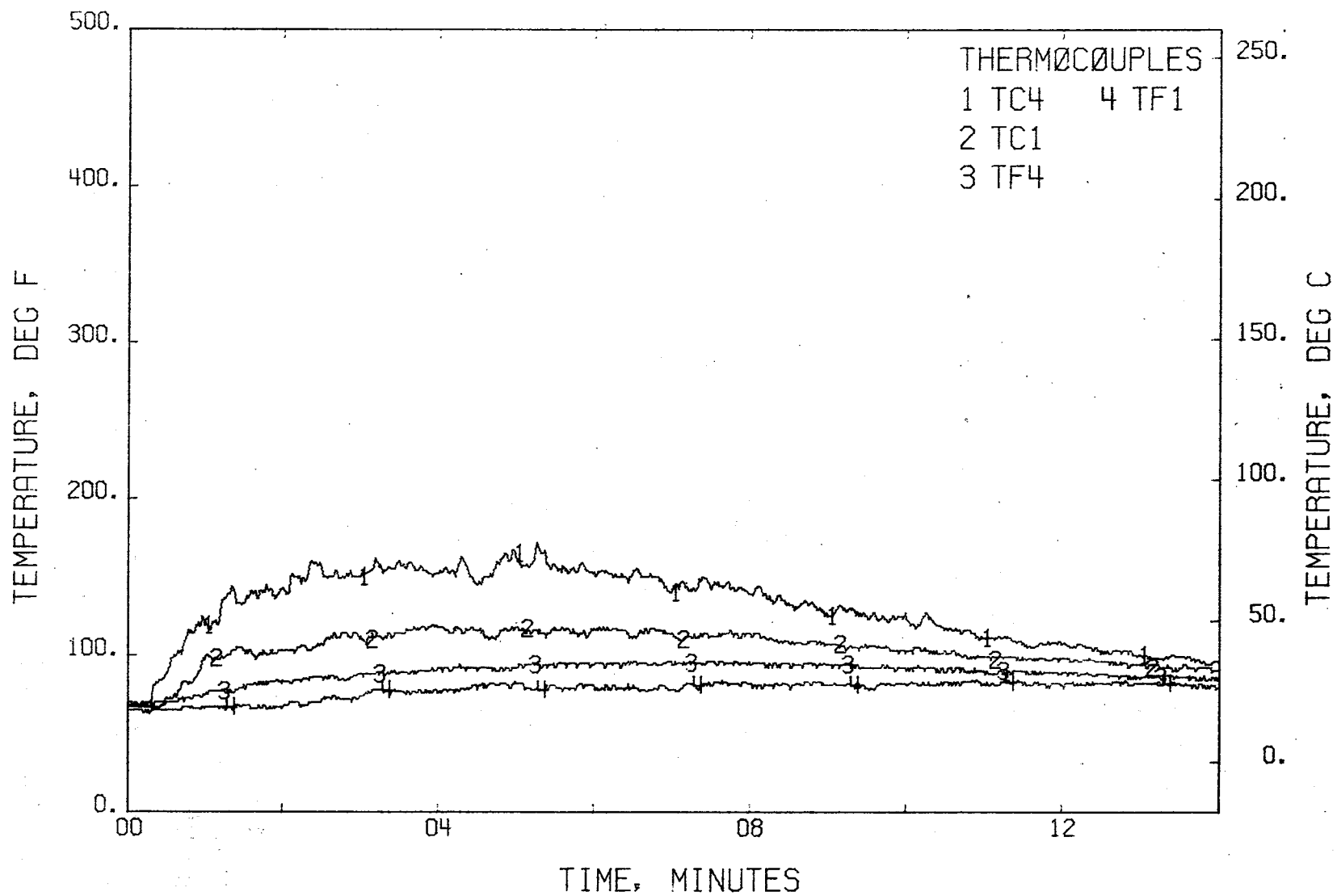


FIGURE 149 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 11

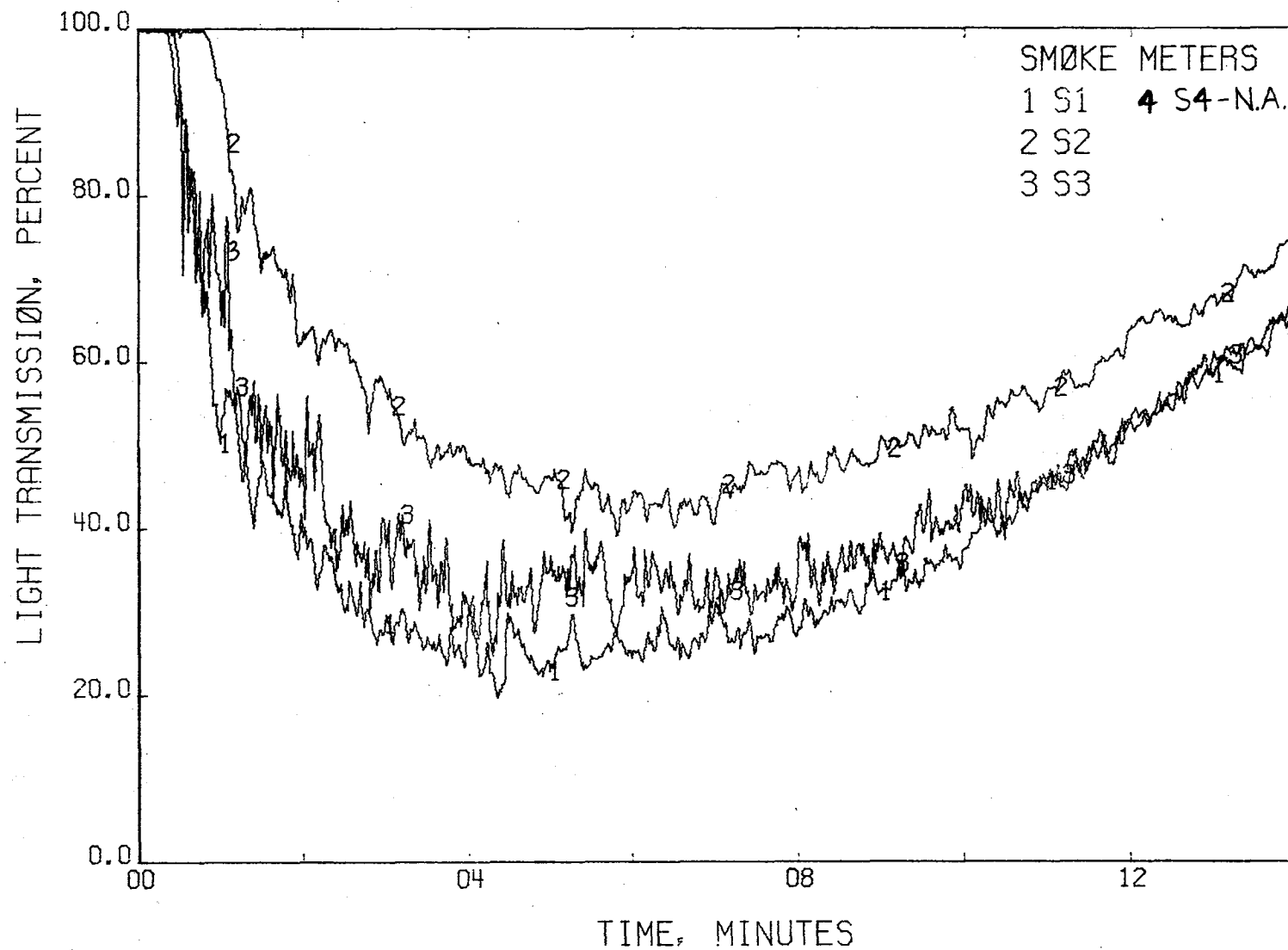


FIGURE 150 . - LIGHT TRANSMISSION  
TEST 11



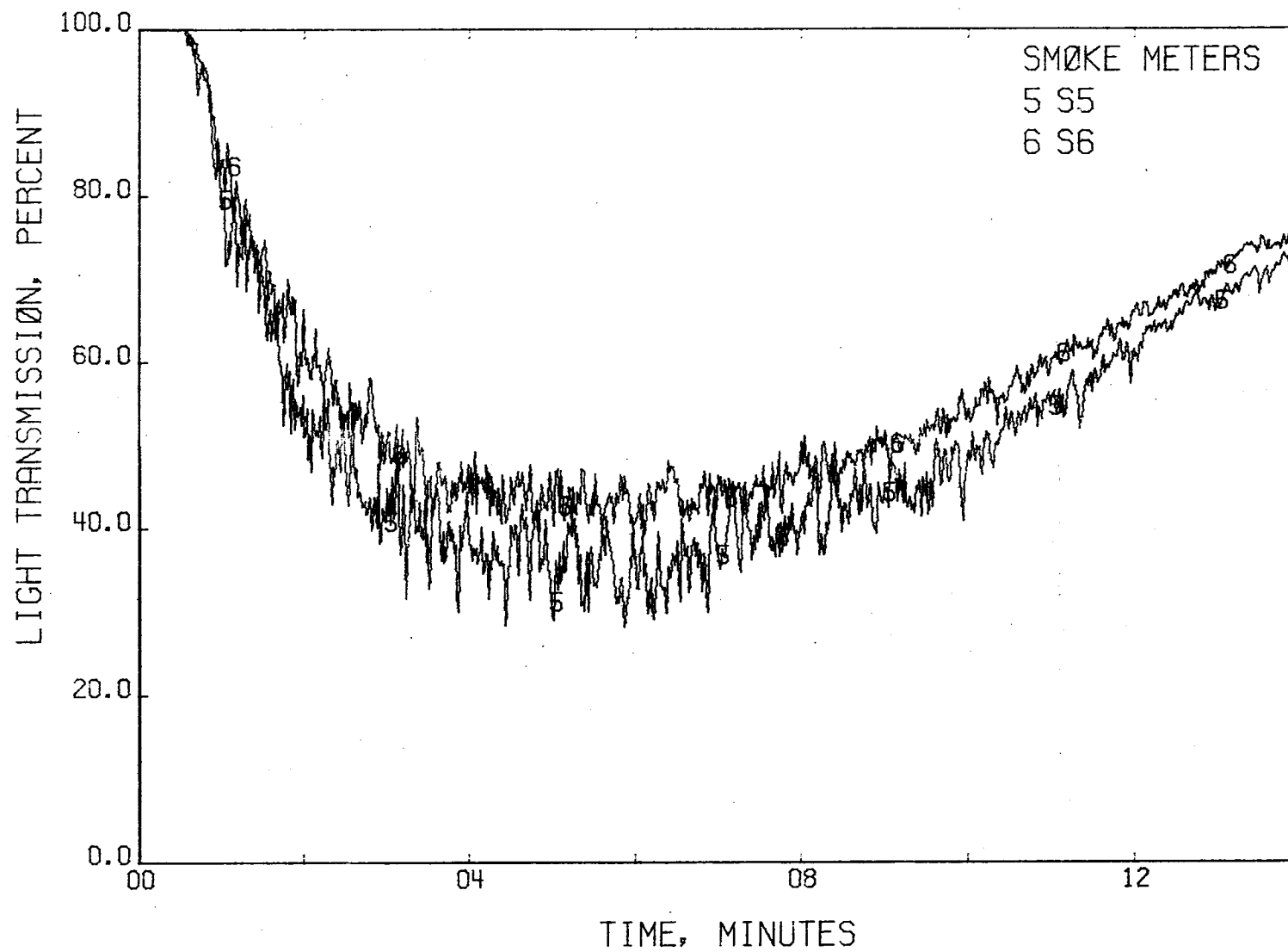


FIGURE 150 . - LIGHT TRANSMISSION-CONT.  
TEST 11

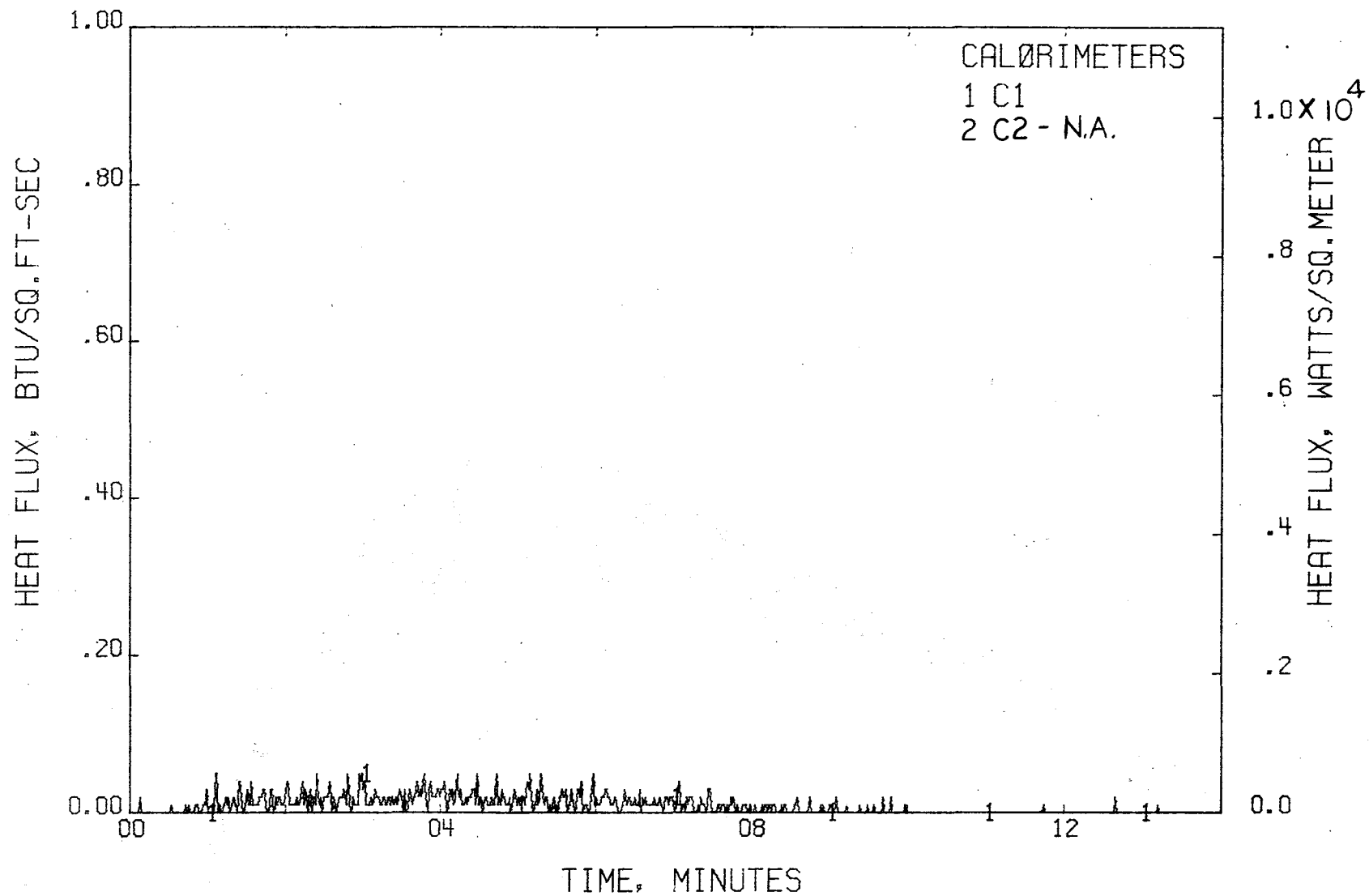


FIGURE 151 . - HEAT FLUX, AFT  
TEST 11

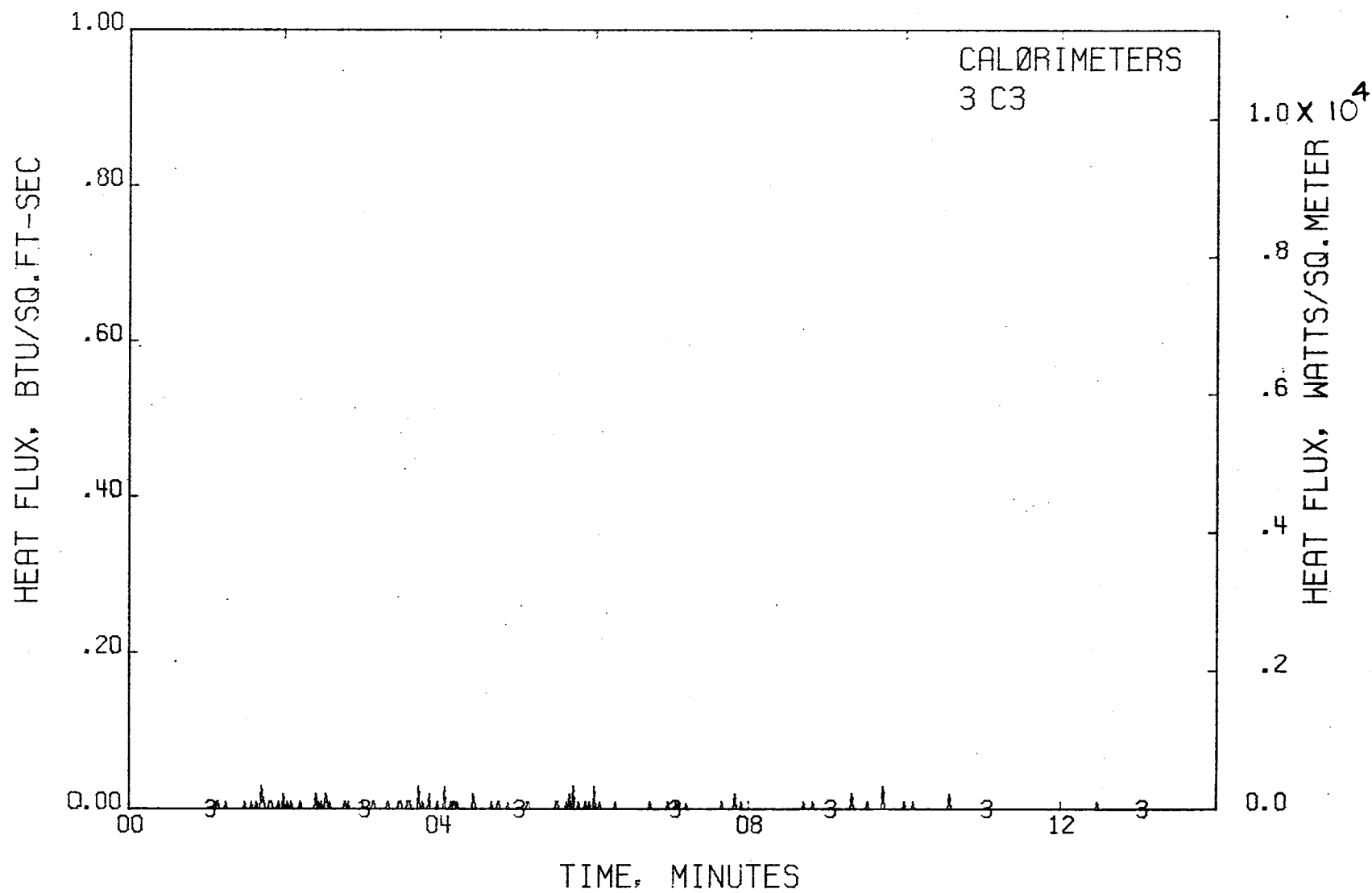


FIGURE 151 . - HEAT FLUX, AFT - CONTINUED  
TEST 11

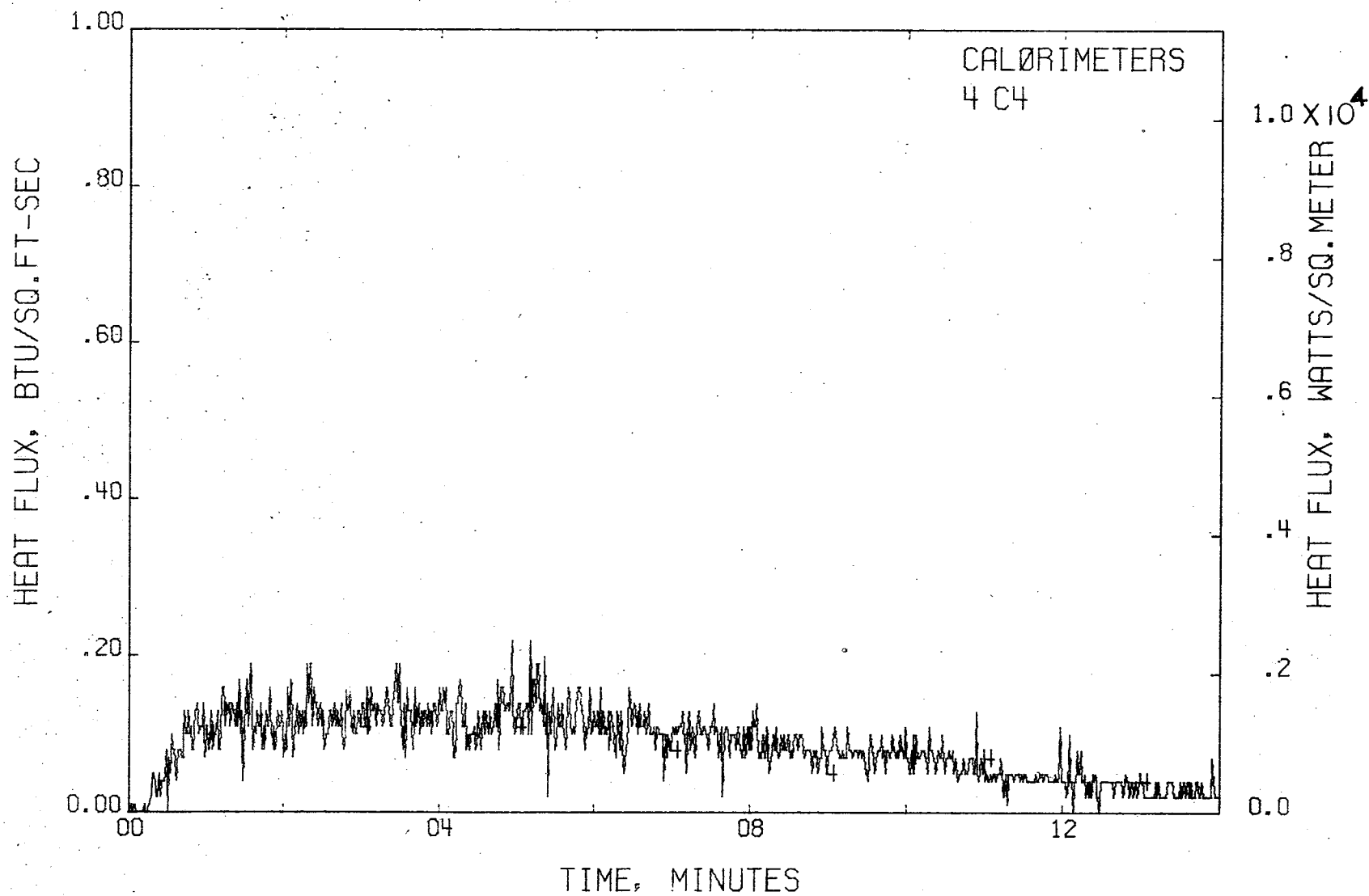


FIGURE 152 . - HEAT FLUX, MIDSECTION  
TEST 11

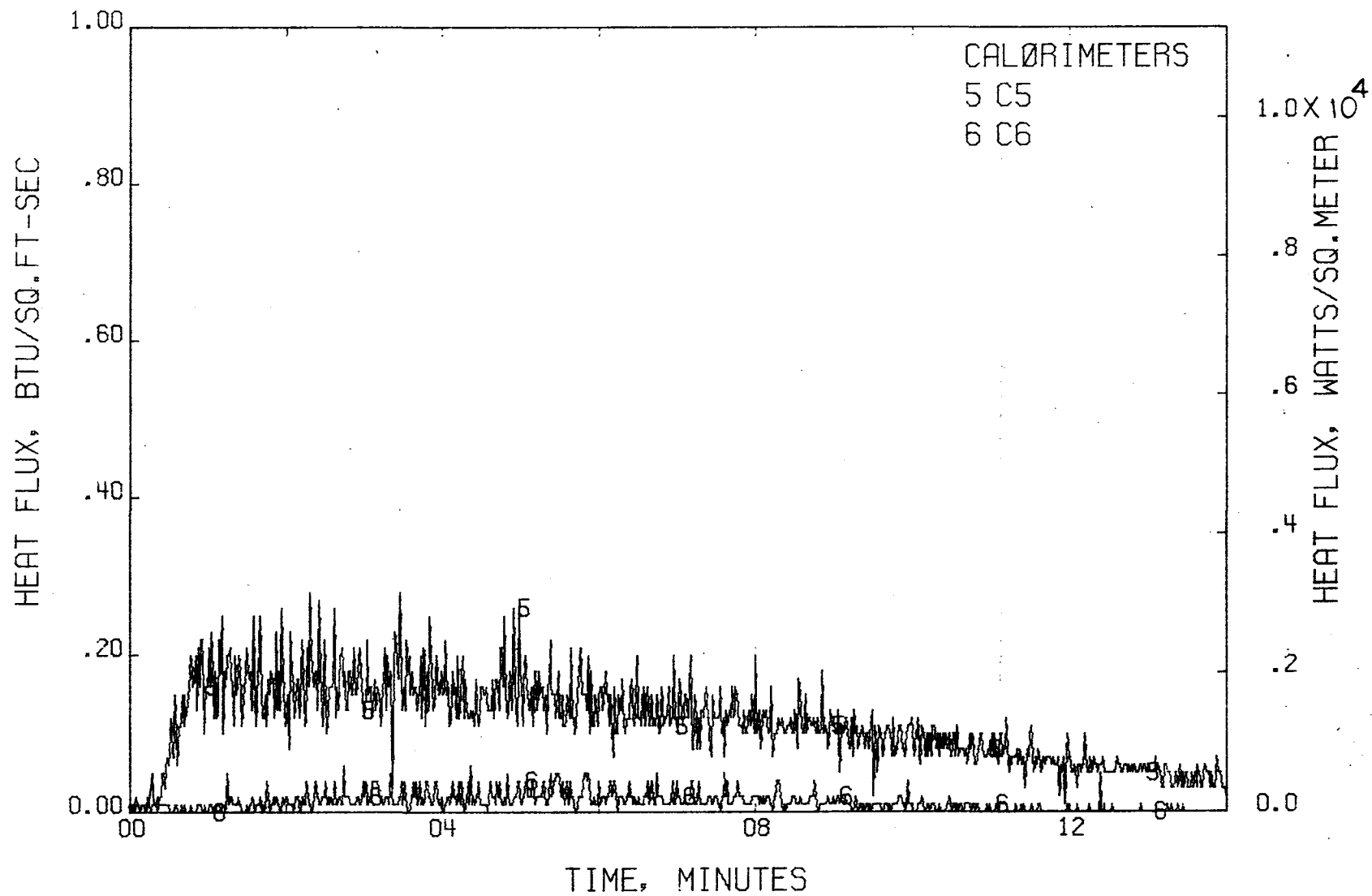


FIGURE 152 . - HEAT FLUX, MIDSECTION-CONT.  
TEST 11

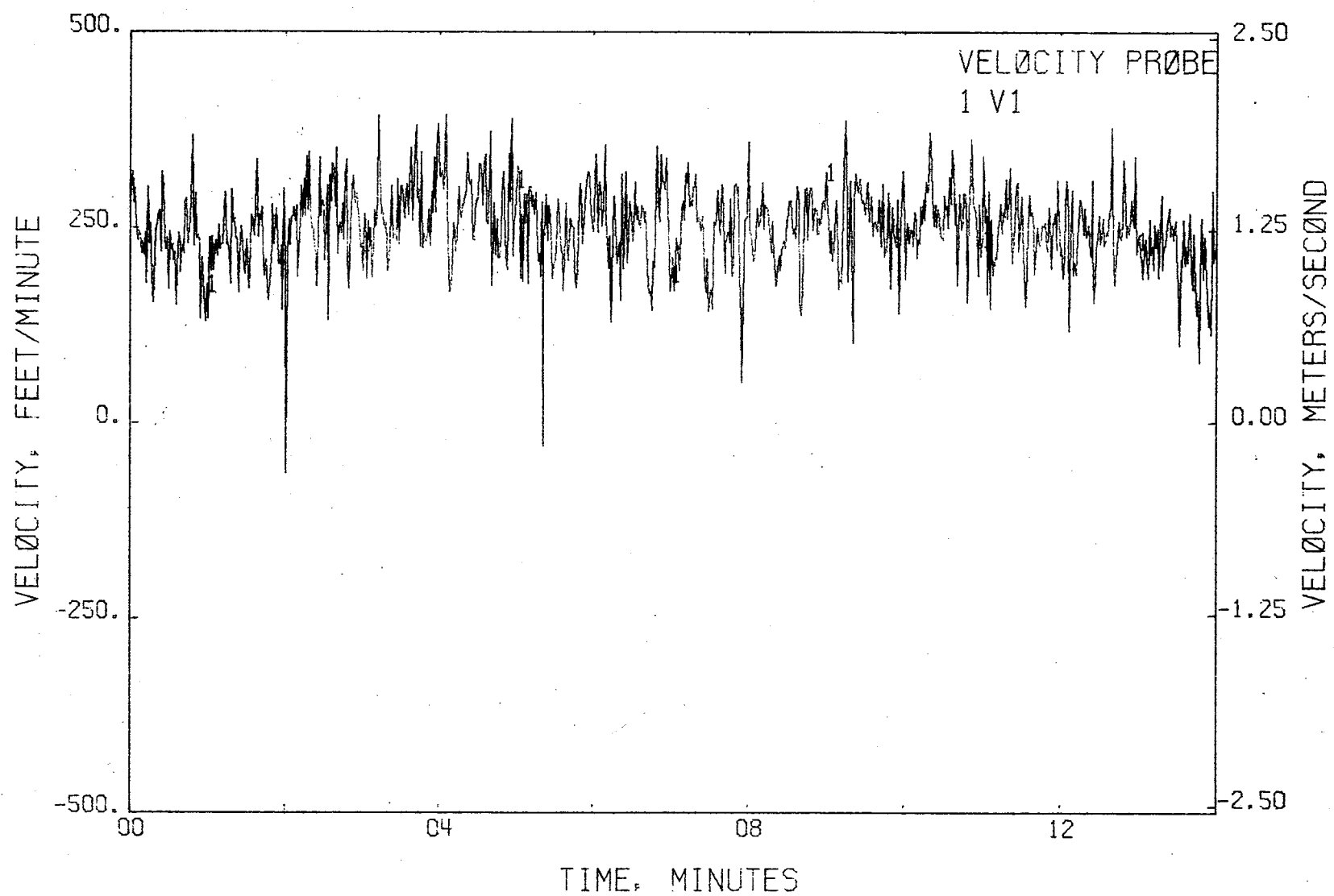


FIGURE 153 . - AIR VELOCITY  
TEST 11

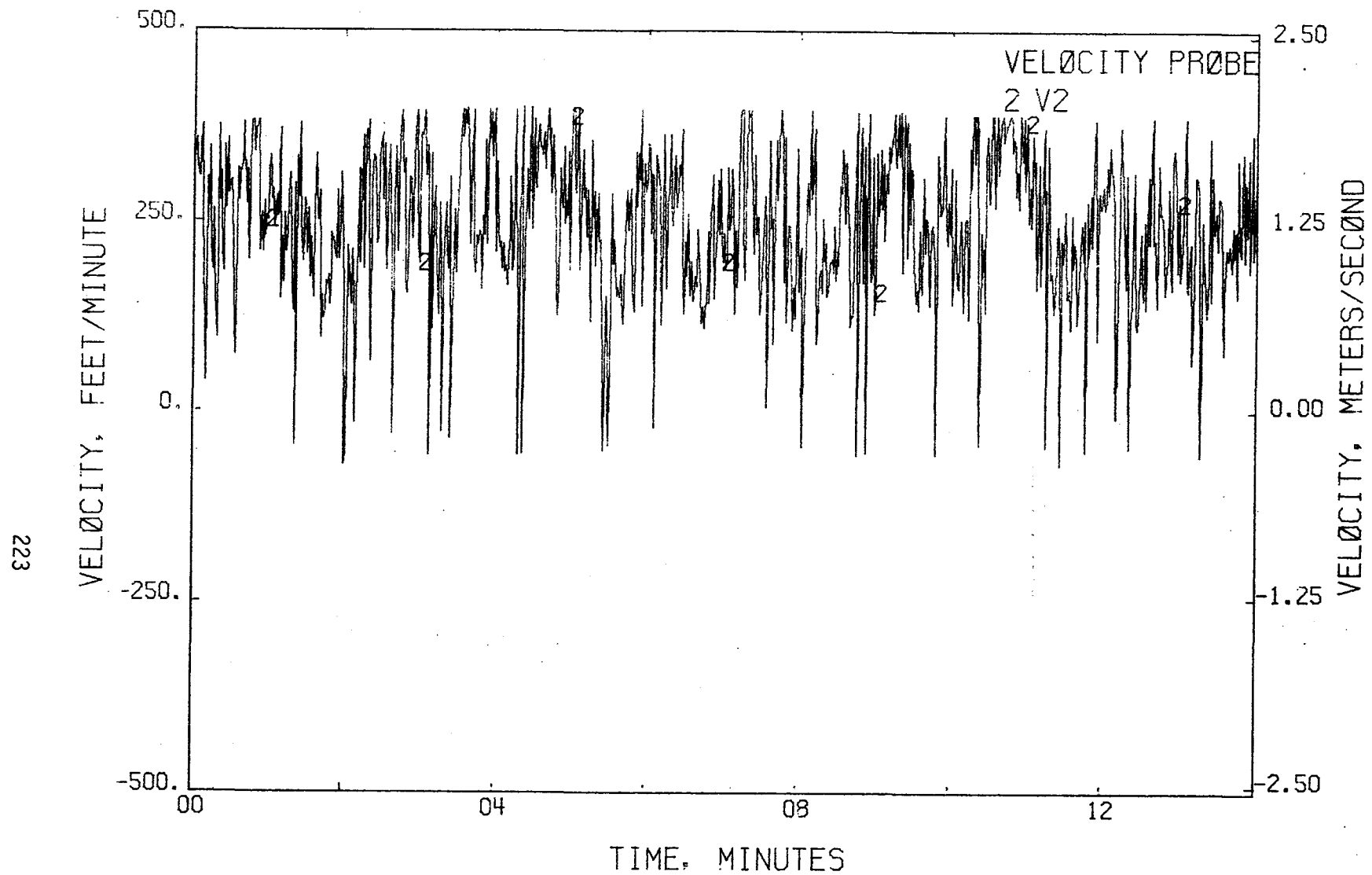


FIGURE 153 . - AIR VELOCITY - CONT.  
TEST 11

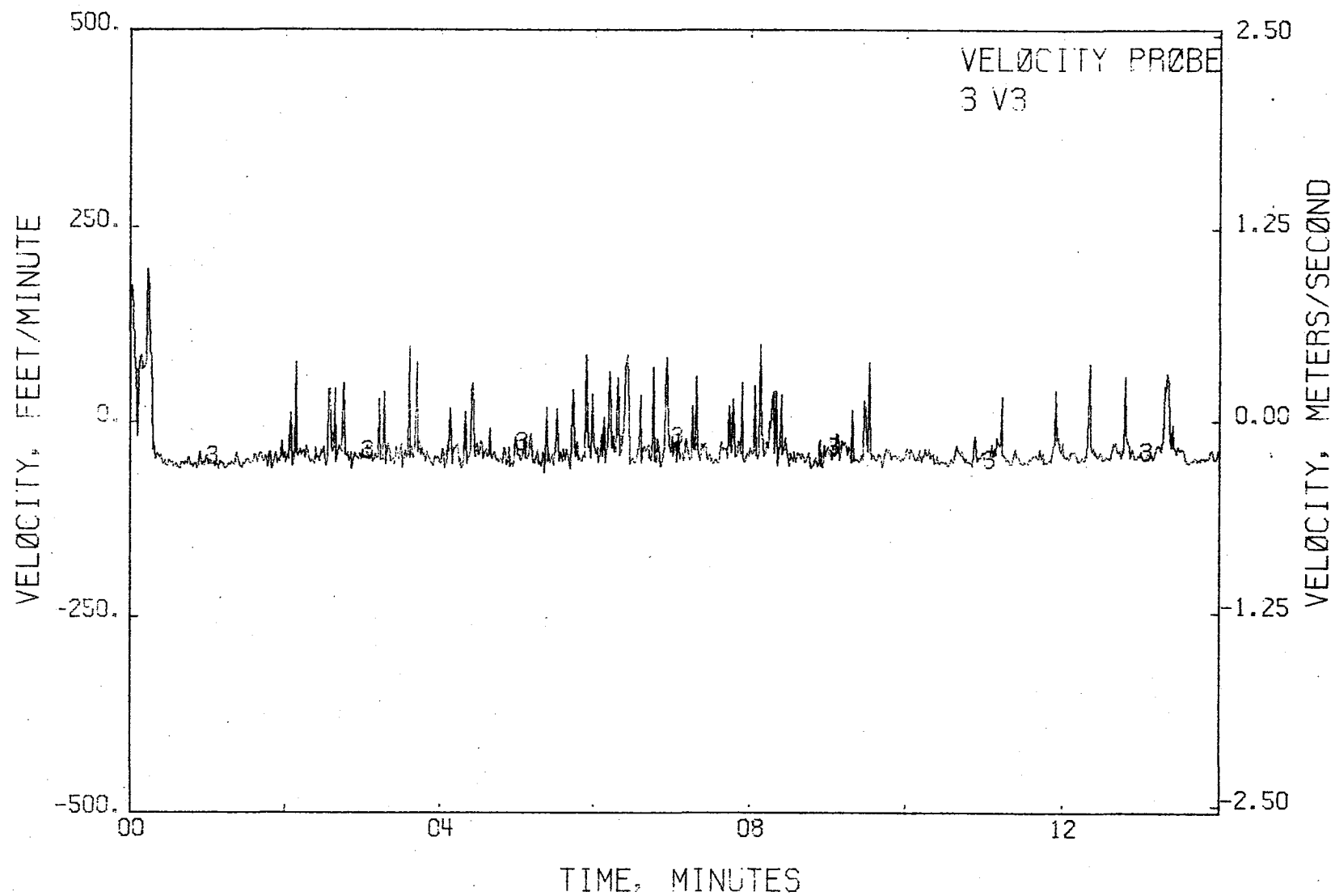


FIGURE 153 - AIR VELOCITY - CONT.  
TEST 11



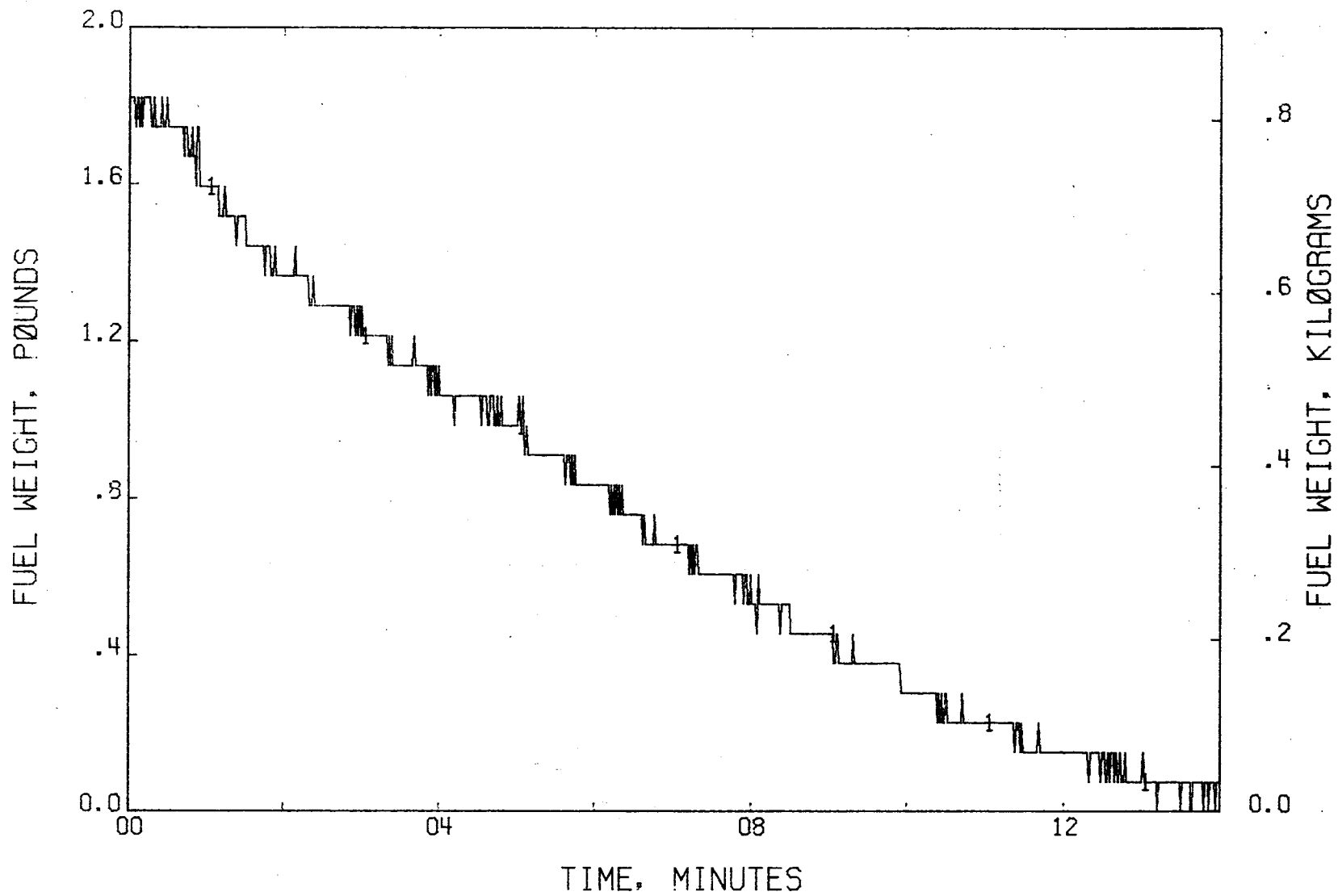


FIGURE 154 . - FUEL WEIGHT LOSS  
TEST 11

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 6 PPM

HYDROGEN FLUORIDE - < 6 PPM

HYDROGEN CHLORIDE - < 12 PPM

DUE TO EQUIPMENT PROBLEMS, ONLY THE PEAK VALUES  
WERE OBTAINED IN THIS TEST FOR THE NON-HYDROLYZABLE  
GASES, AS SHOWN BELOW:

---

o MAXIMUM CARBON MONOXIDE CONCENTRATION	54 ppm
o MAXIMUM CARBON DIOXIDE CONCENTRATION	0.35%
o MINIMUM OXYGEN CONCENTRATION	20.7%
o MAXIMUM HYDROCARBON CONCENTRATION	29 ppm

FIGURE 156 . - CO, CO<sub>2</sub>, O<sub>2</sub>, and HYDROCARBONS CONCENTRATIONS  
TEST 11



TEST 12

---

BARE URETHANE FOAM SEATS (CUSHIONS ONLY)

TEST 12

BARE URETHANE FOAM SEATS (CUSHIONS ONLY)

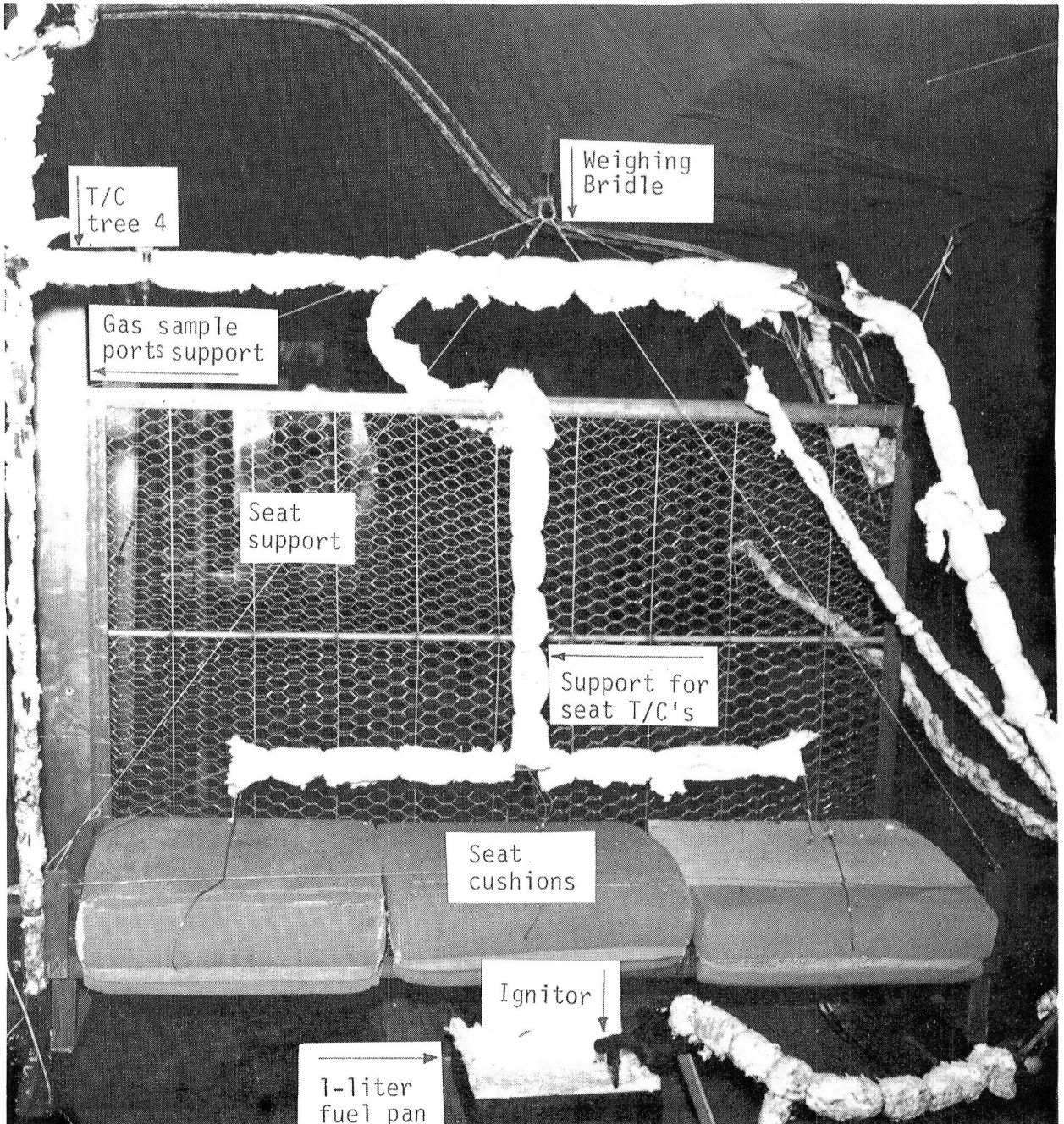


FIGURE 157 . - PRE-TEST CONFIGURATION, TEST 12

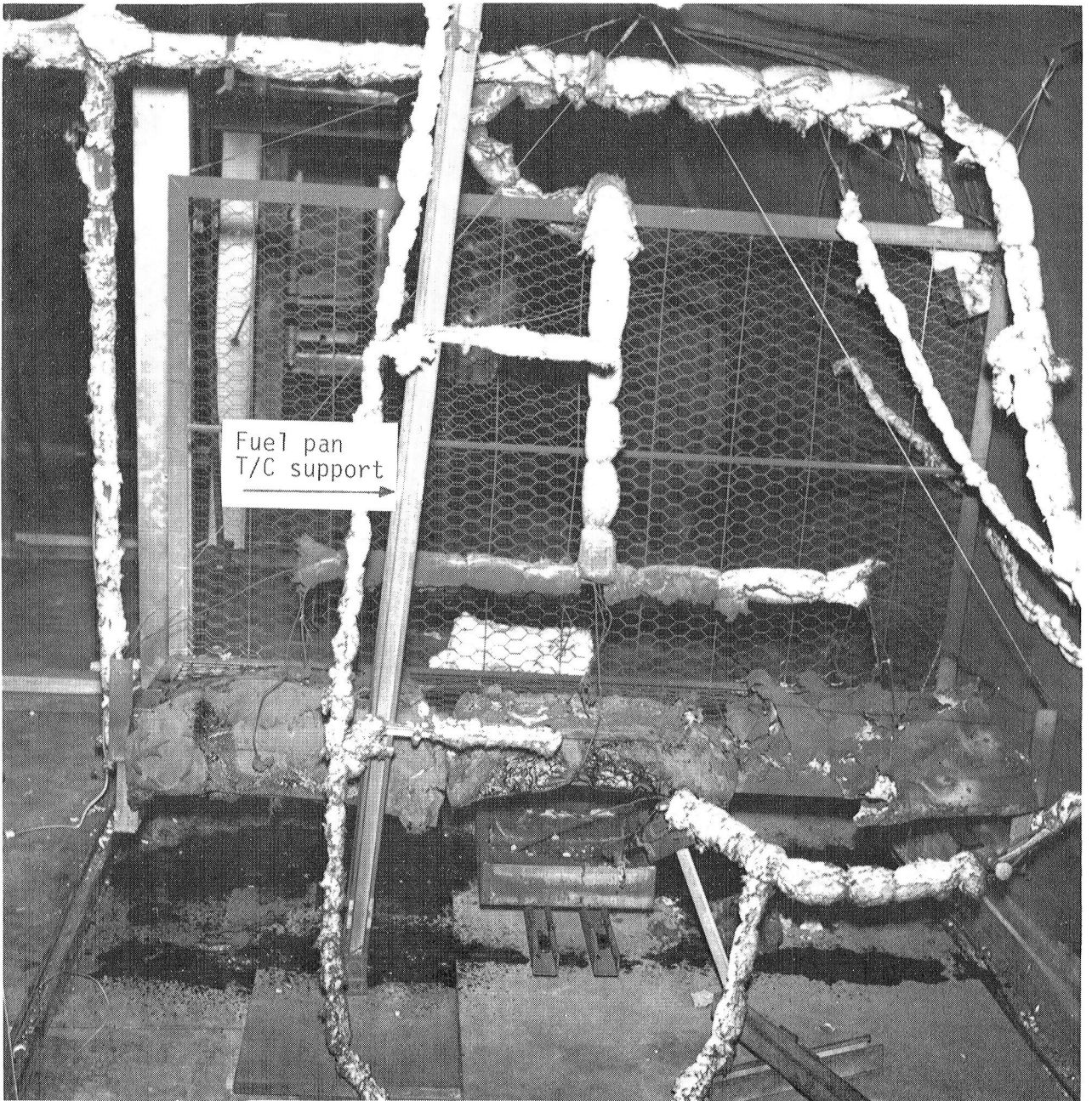


FIGURE 158 . - POST-TEST CONFIGURATION, TEST 12





FIGURE 159 . - FIRE DURING TEST 12



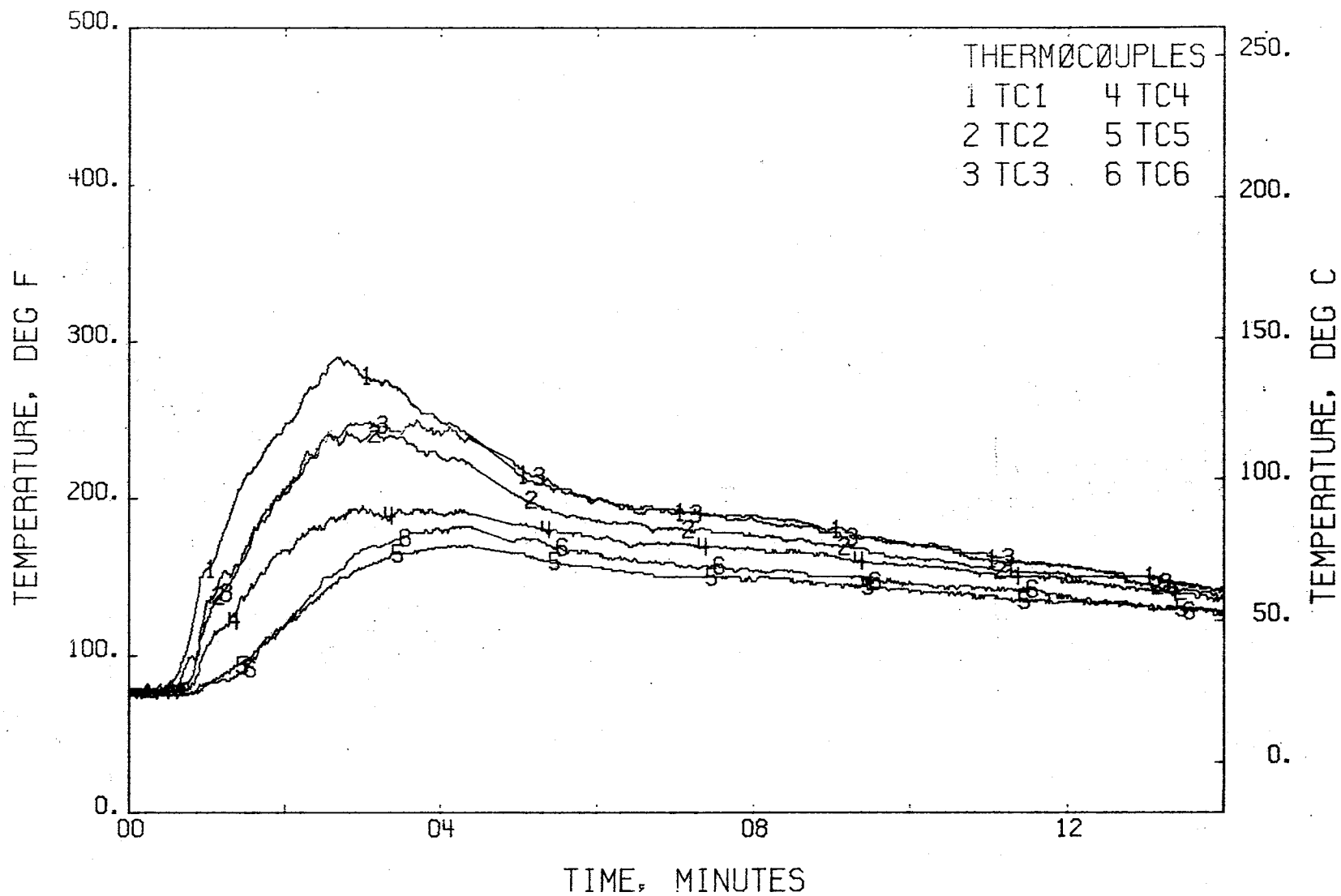


FIGURE 160 . - TEMPERATURES, T/C TREE 1  
TEST 12

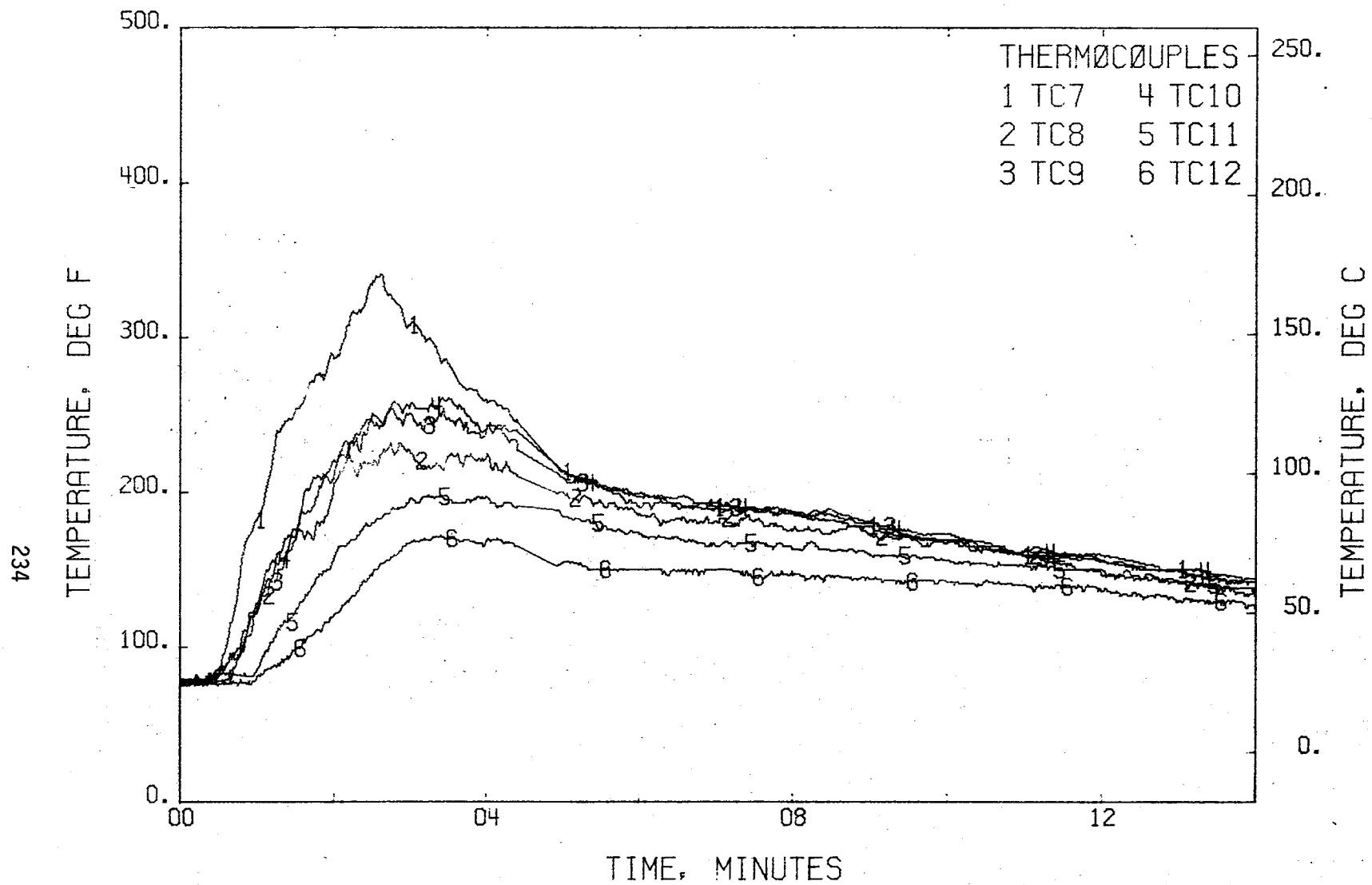


FIGURE 161 . - TEMPERATURES, T/C TREE 2  
TEST 12

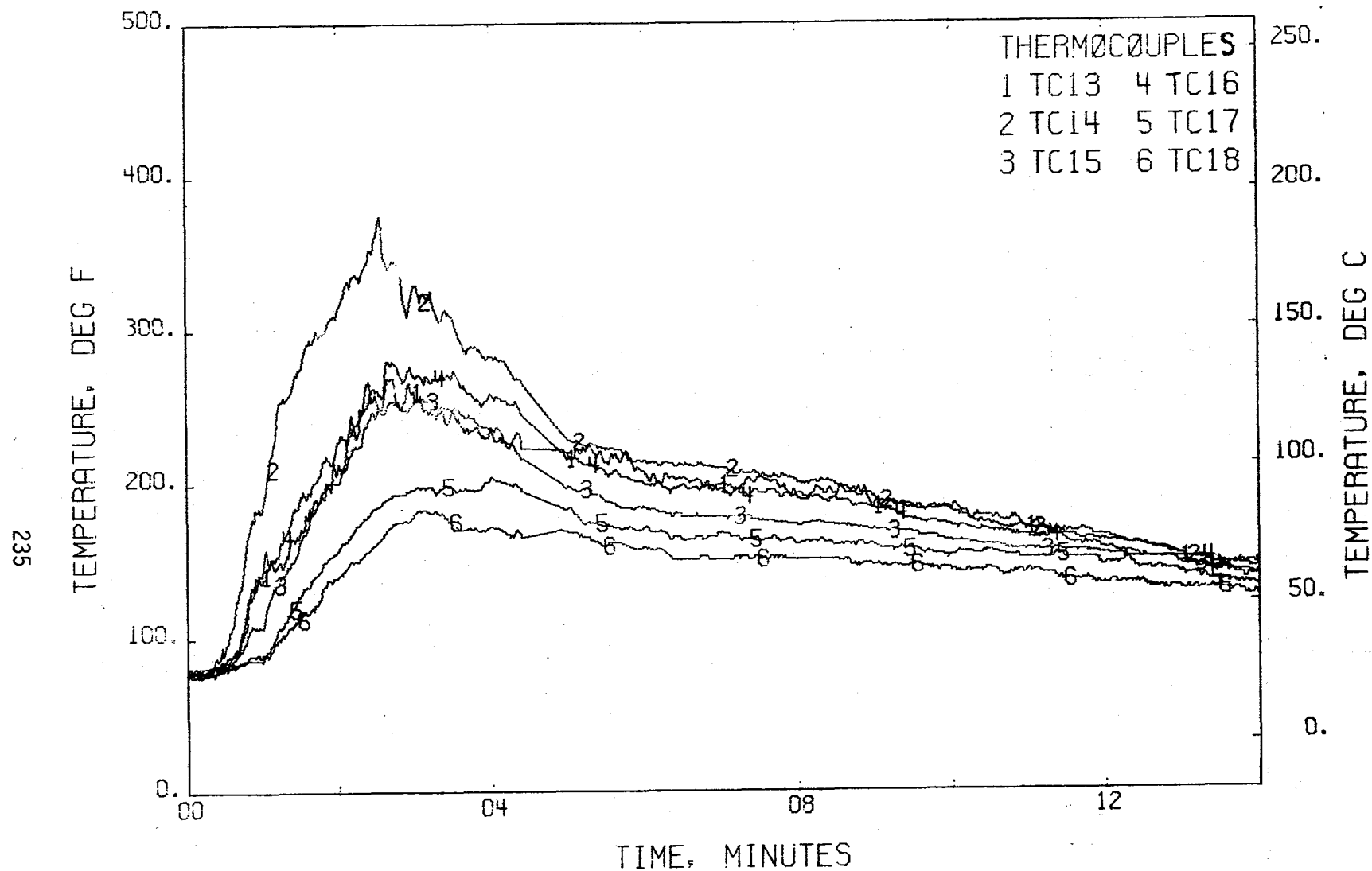


FIGURE 162 . - TEMPERATURES, T/C TREE 3  
TEST 12

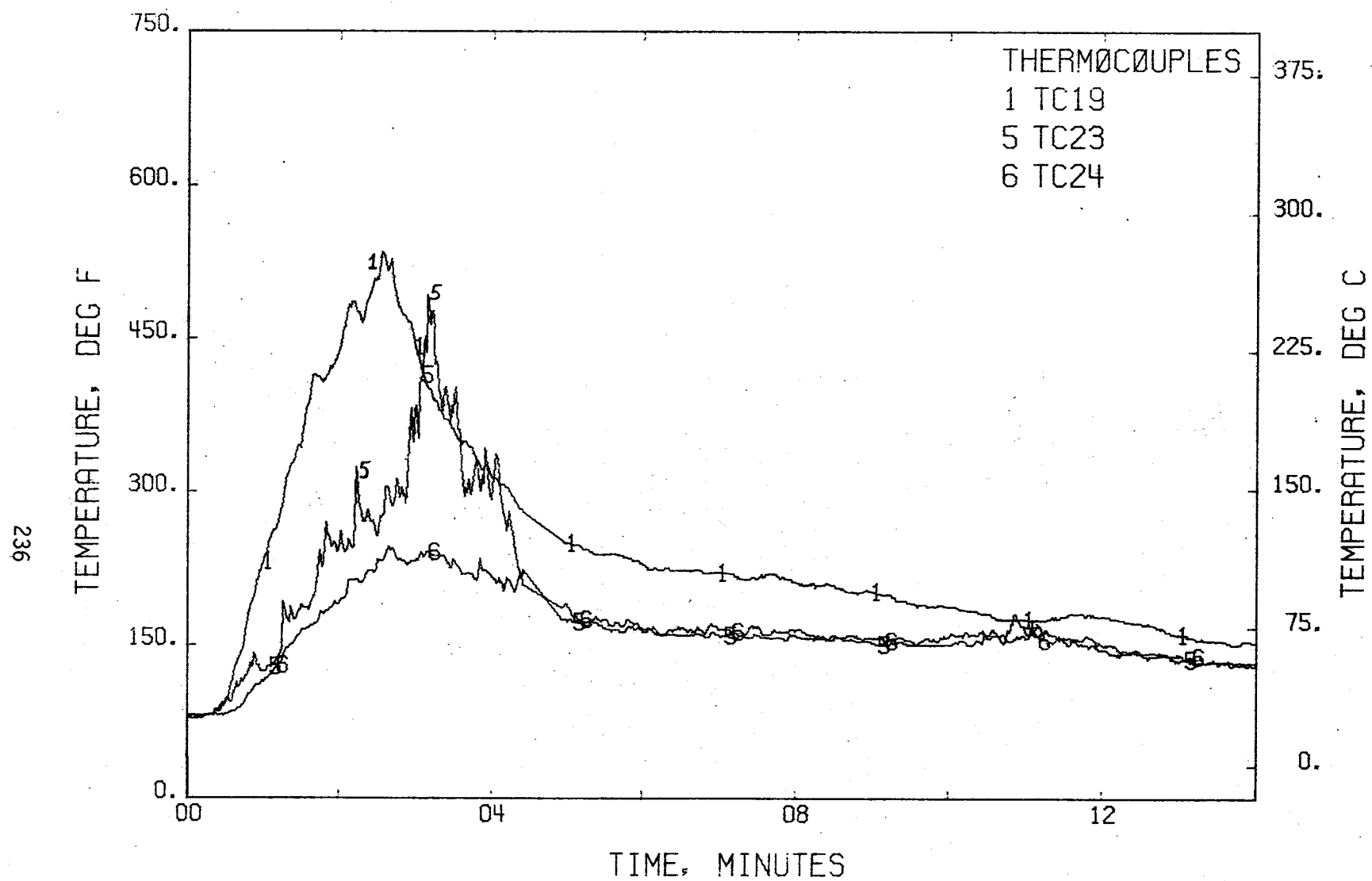


FIGURE 163 . - TEMPERATURES, T/C TREE 4  
TEST 12

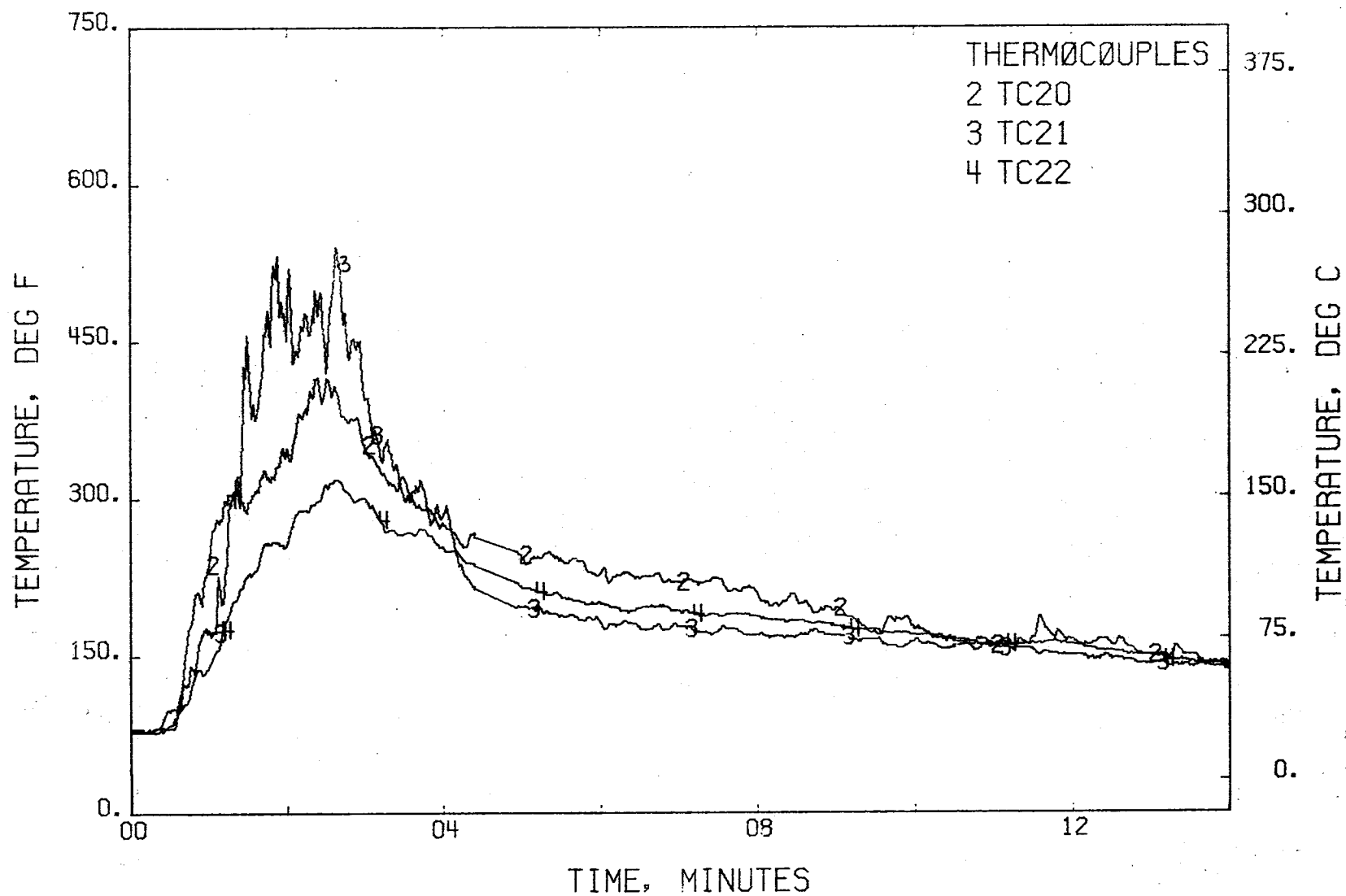


FIGURE 163 . - TEMPERATURES, T/C TREE 4 - CONTINUED  
TEST 12

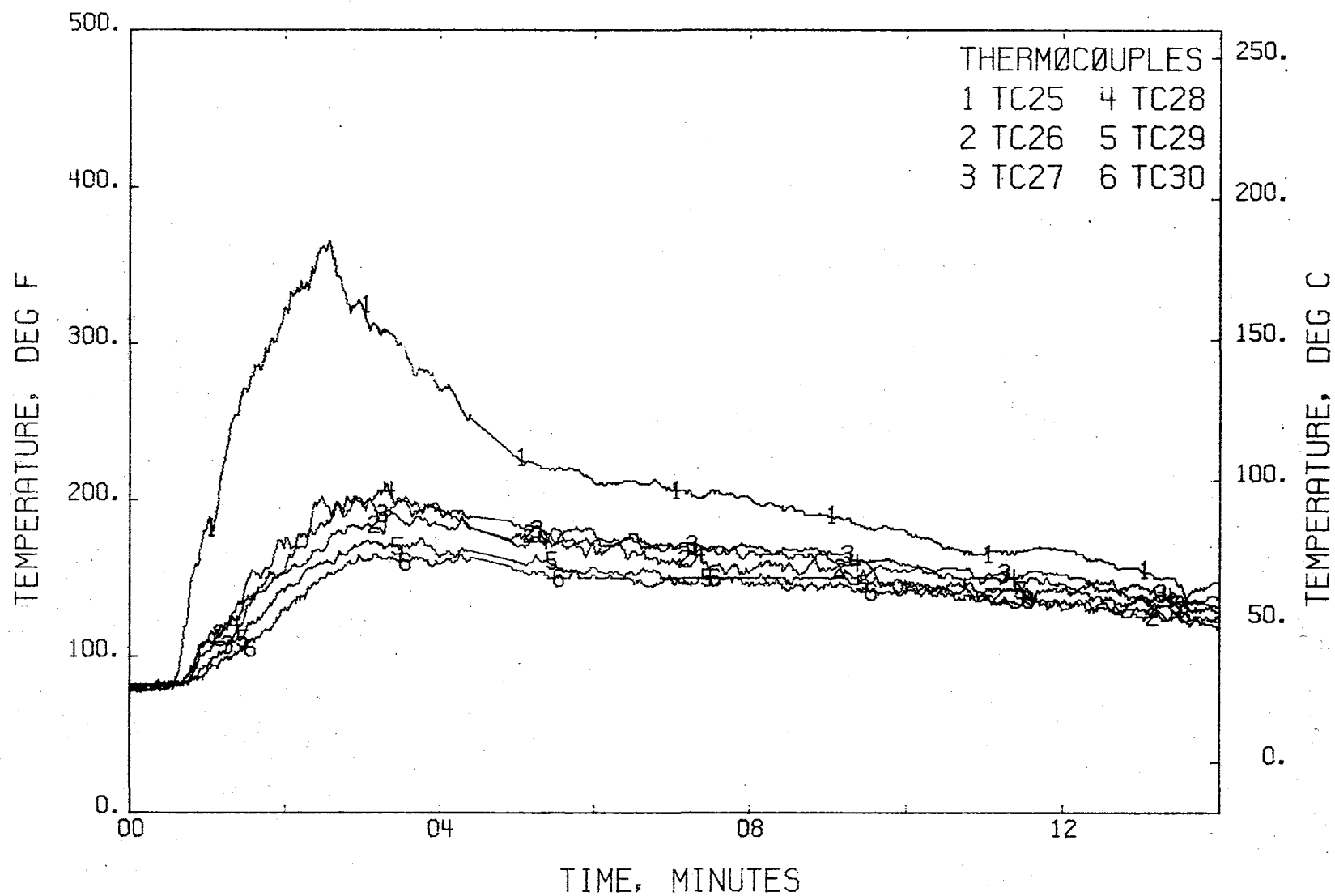


FIGURE 164 . - TEMPERATURES, T/C TREE 5  
TEST 12

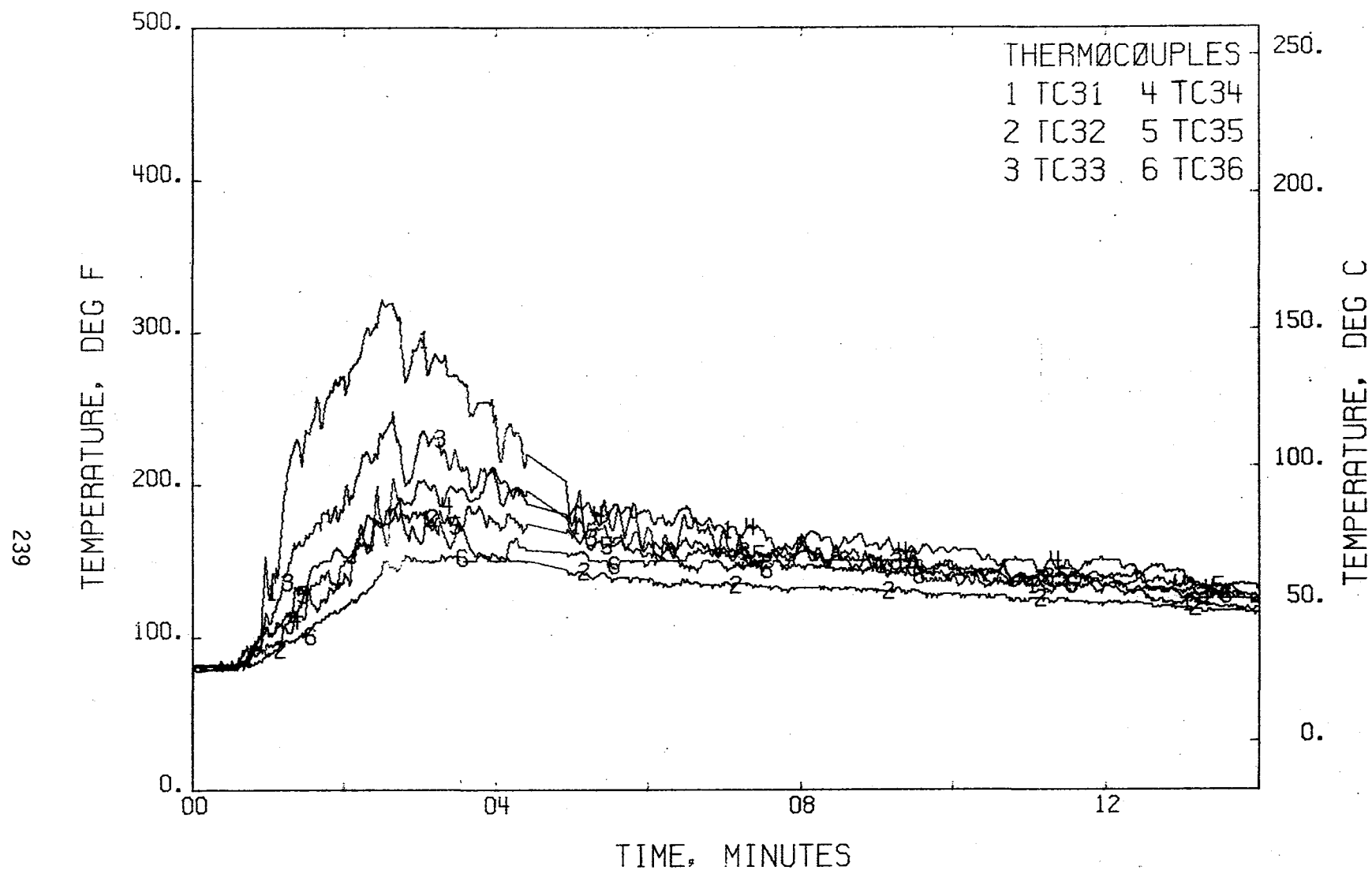


FIGURE 165 . - TEMPERATURES, T/C TREE 6  
TEST 12

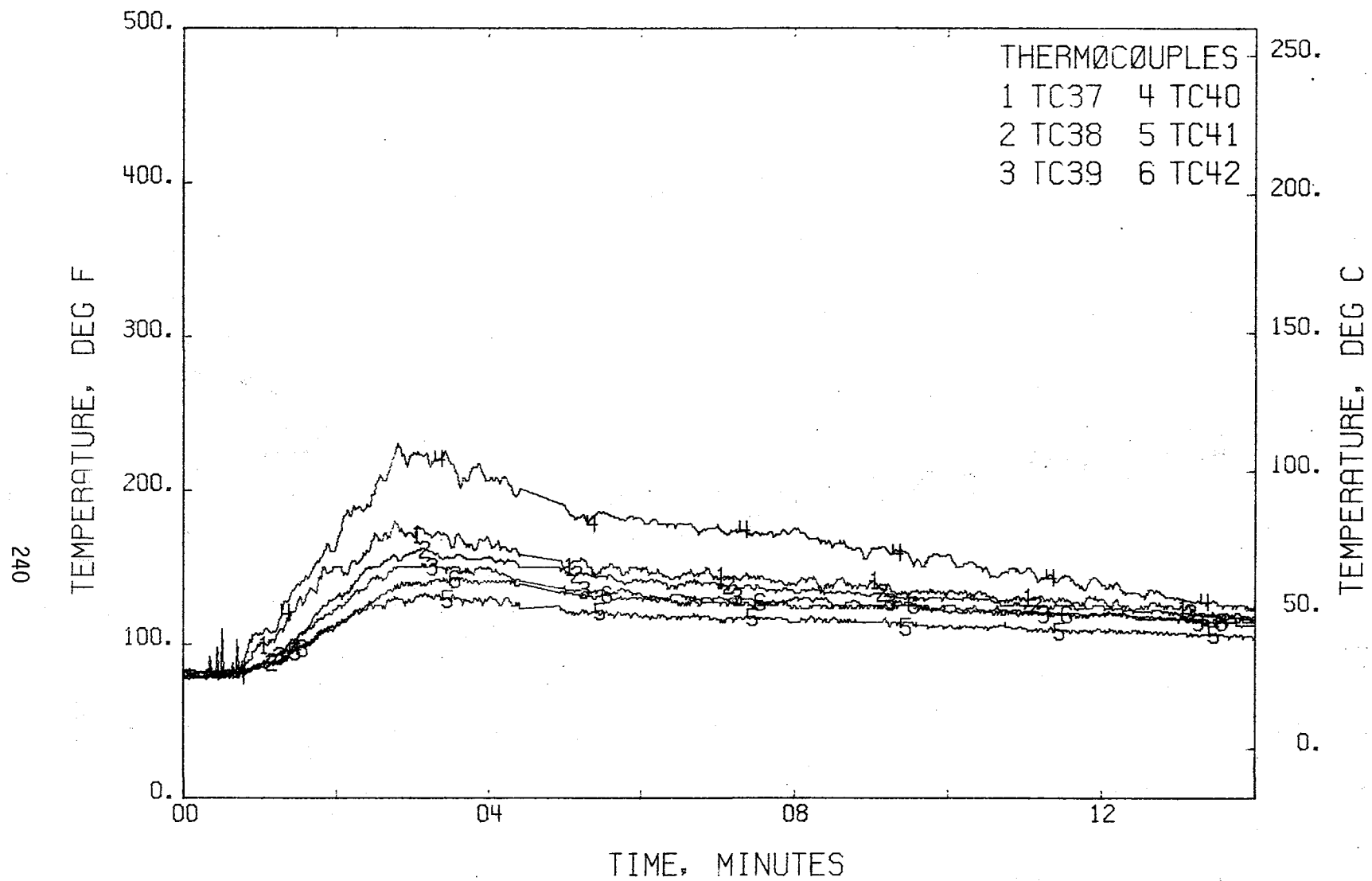


FIGURE 166 . - TEMPERATURES, T/C TREE 7  
TEST 12



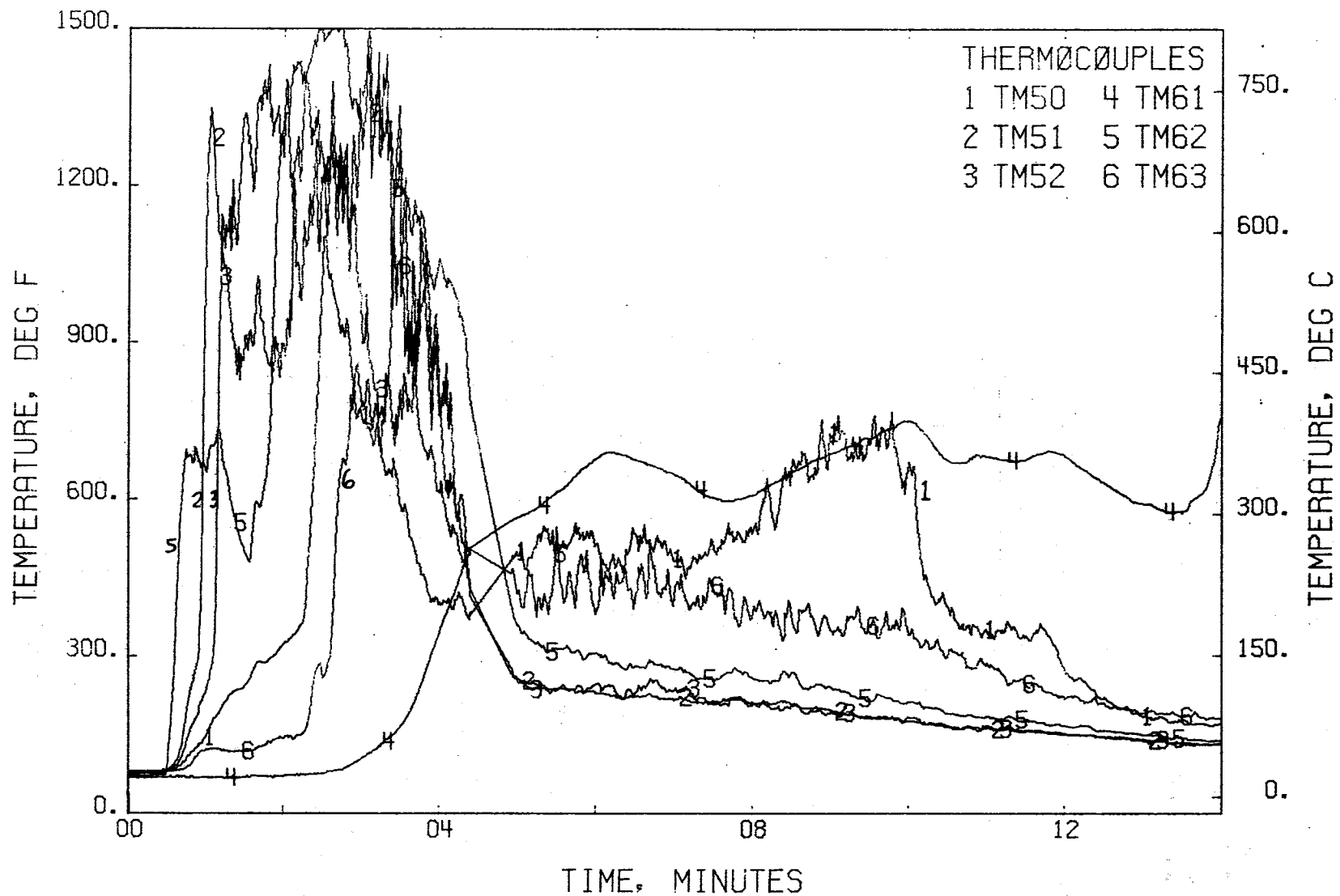


FIGURE 167 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 12

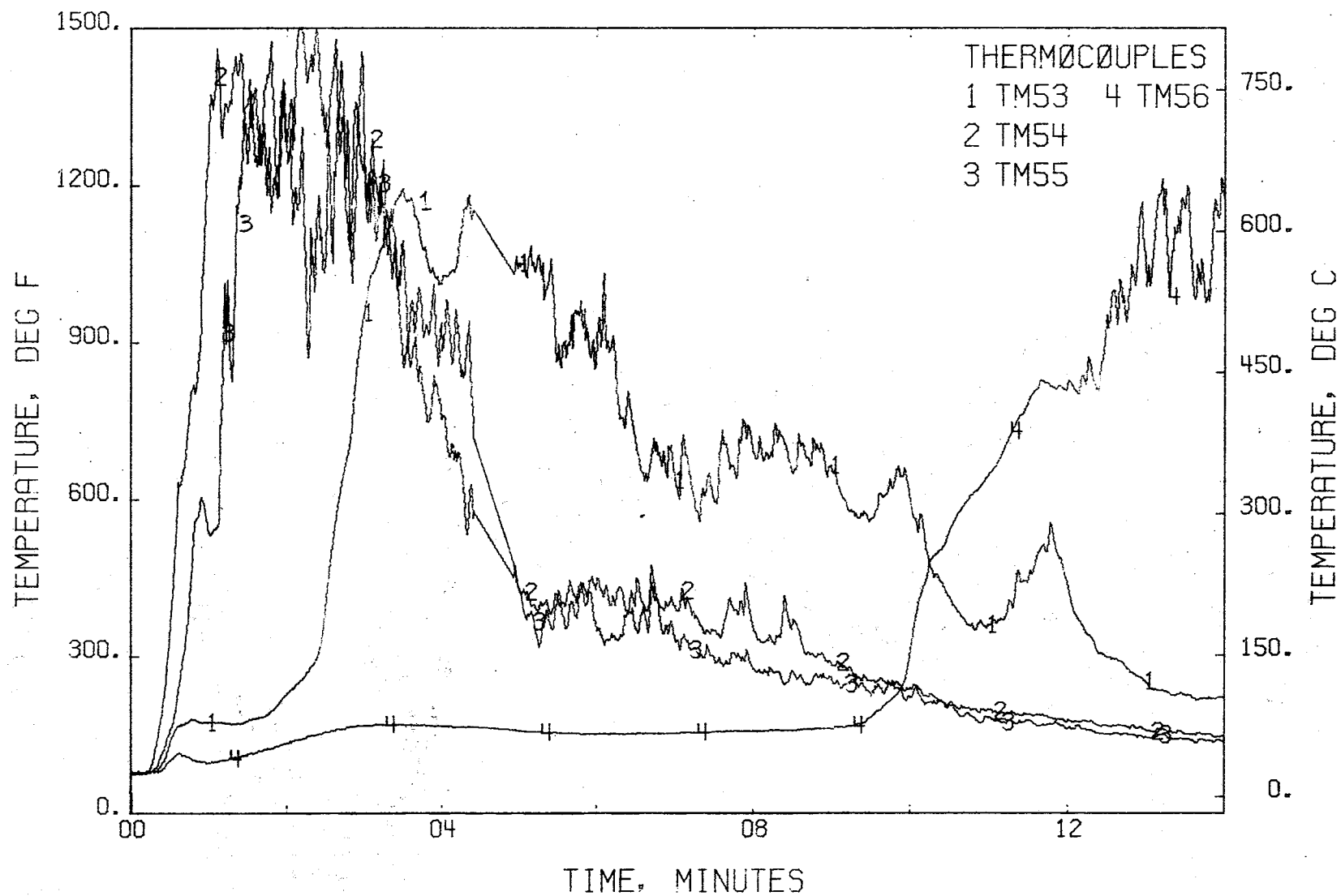


FIGURE 168 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 12

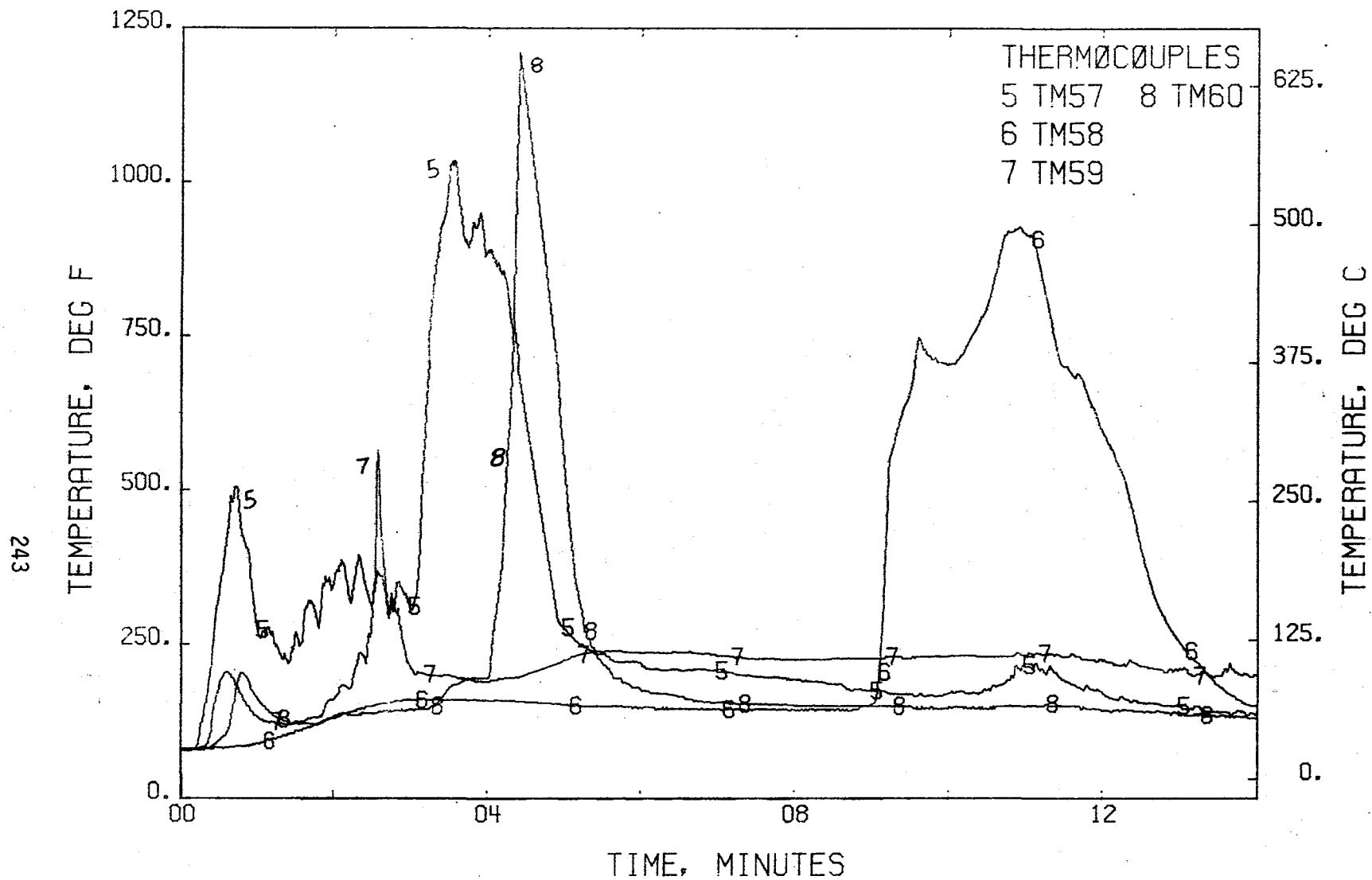


FIGURE 168 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 12

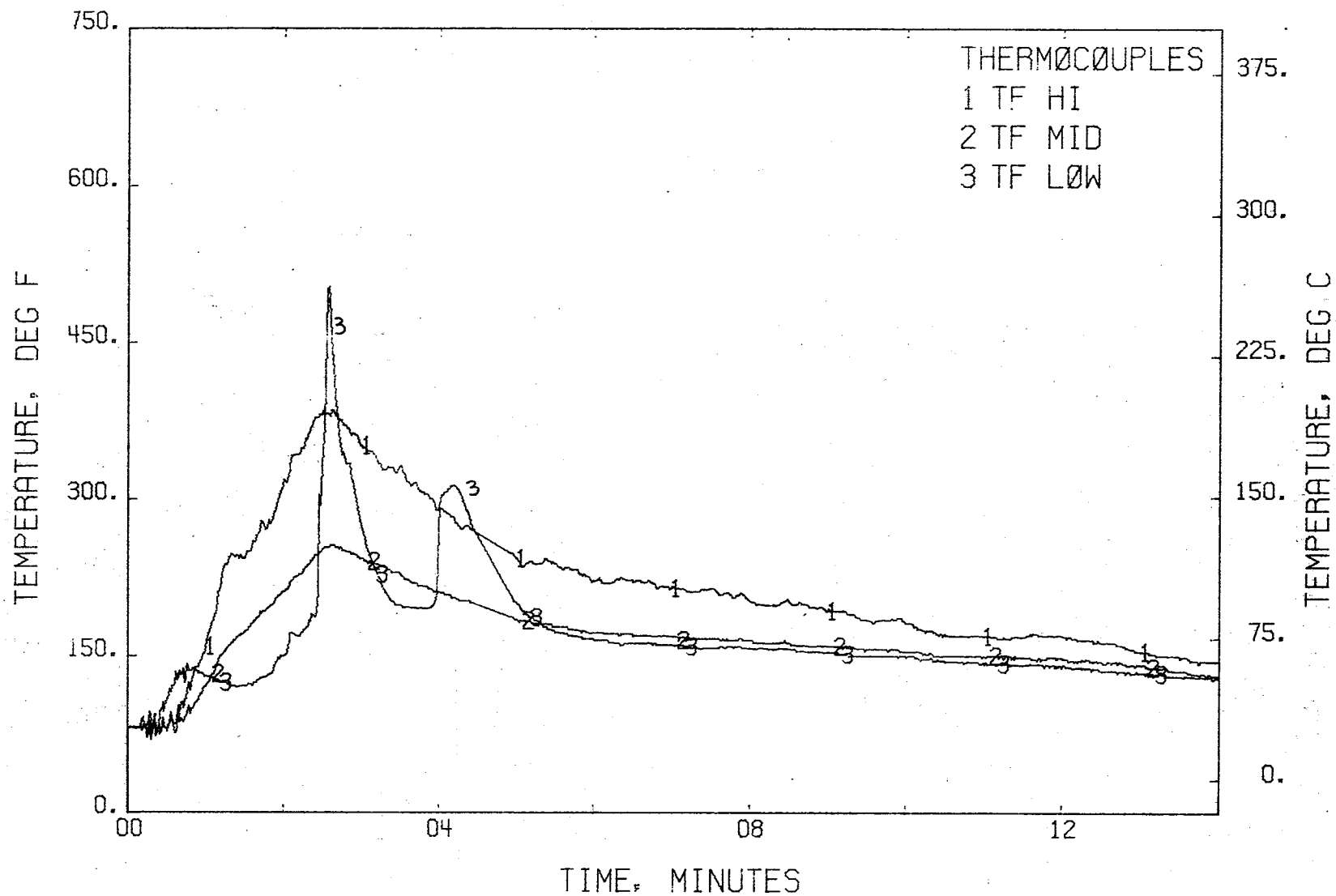


FIGURE 169 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 12

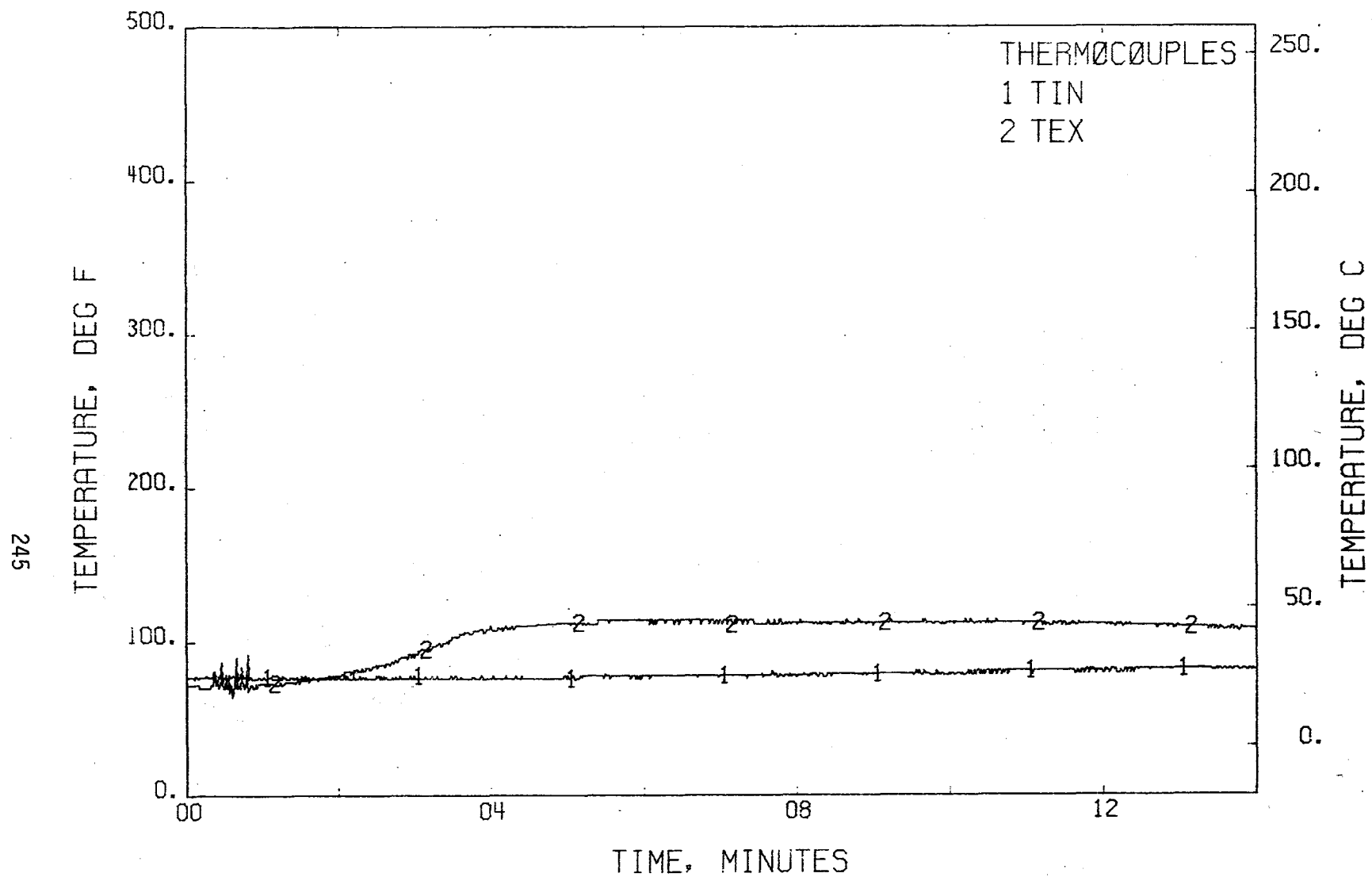


FIGURE 170 . - TEMPERATURES, INLET + EXIT  
TEST 12

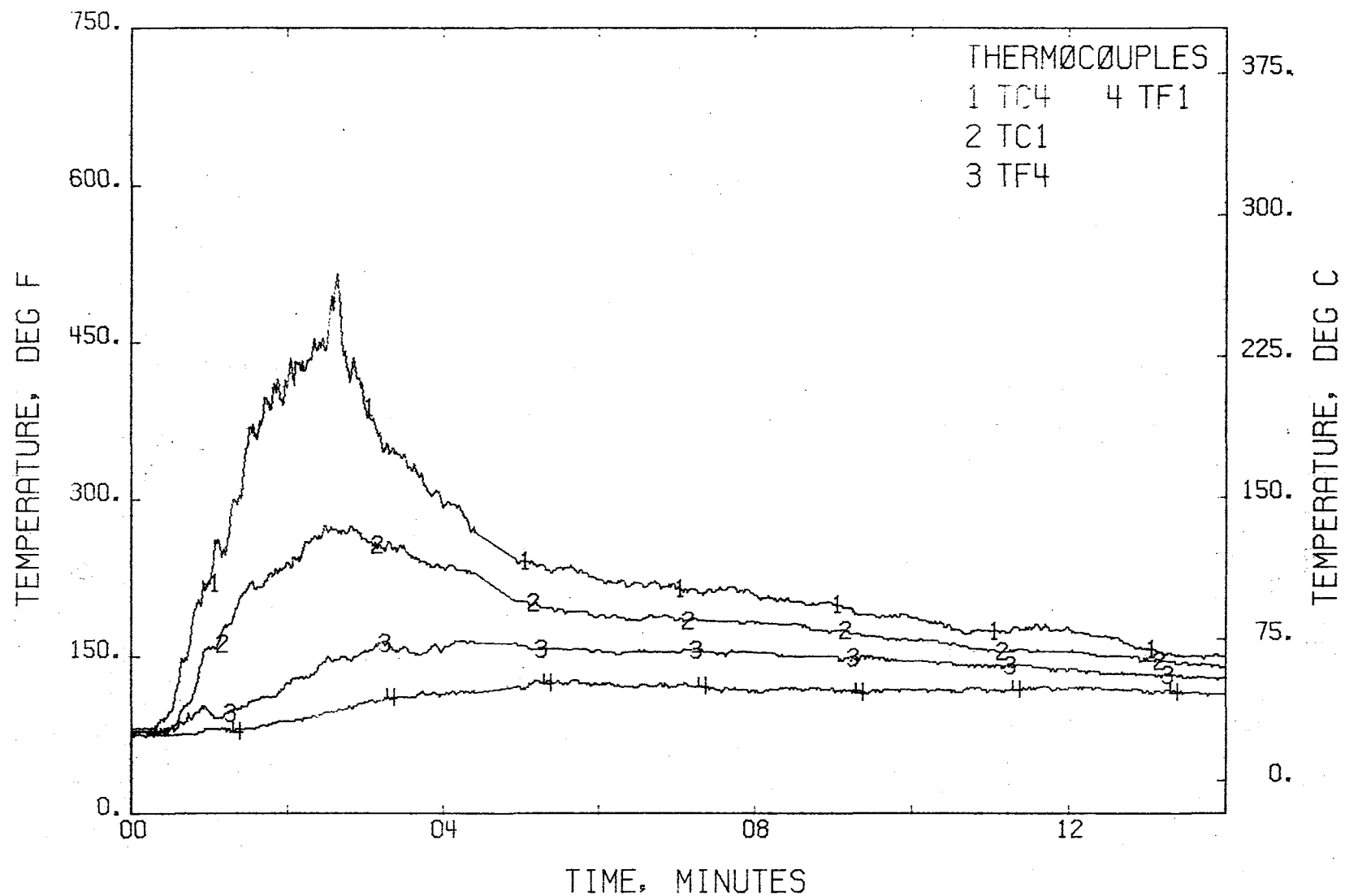


FIGURE 171 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 12

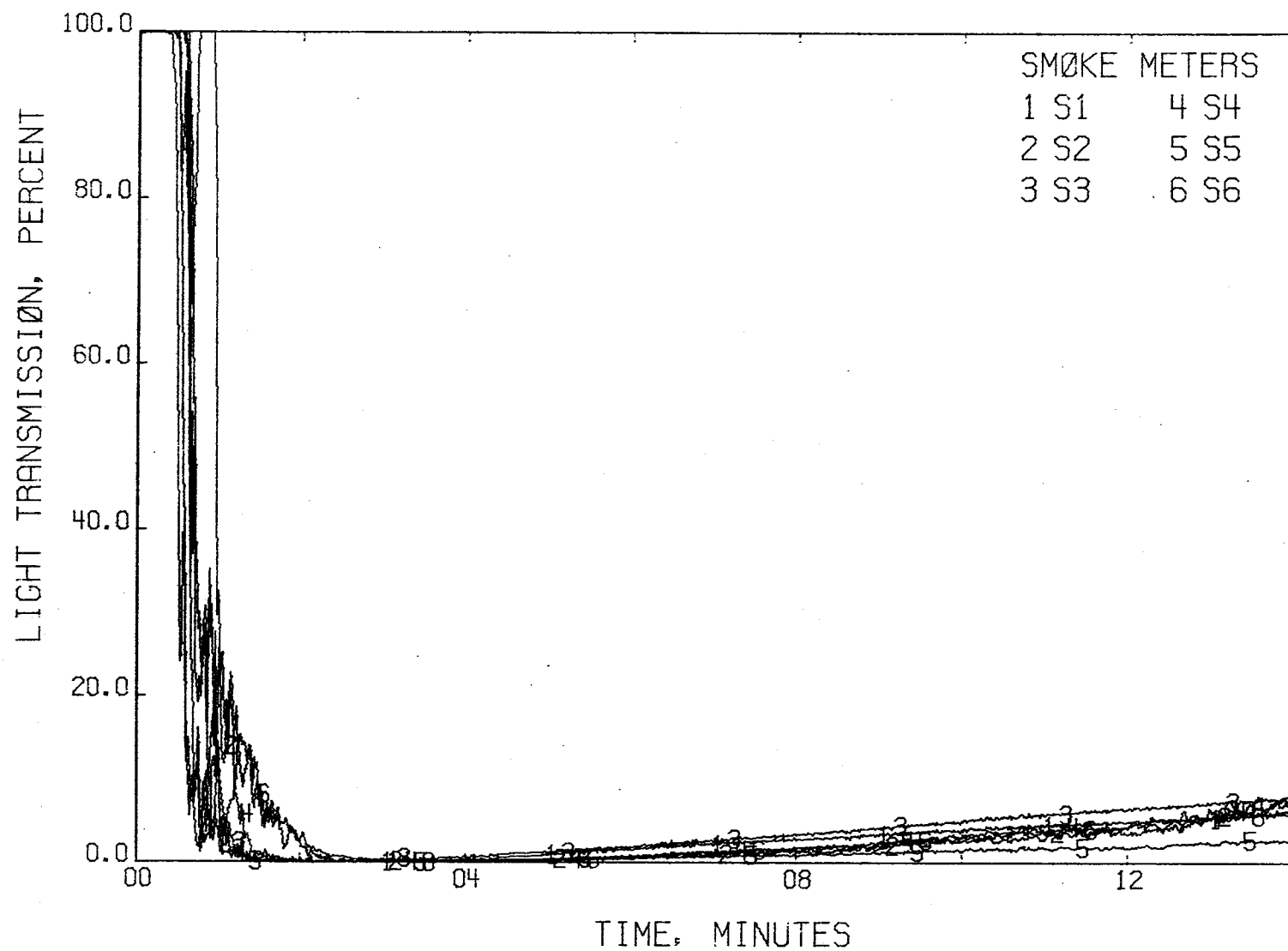


FIGURE 172 . - LIGHT TRANSMISSION  
TEST 12

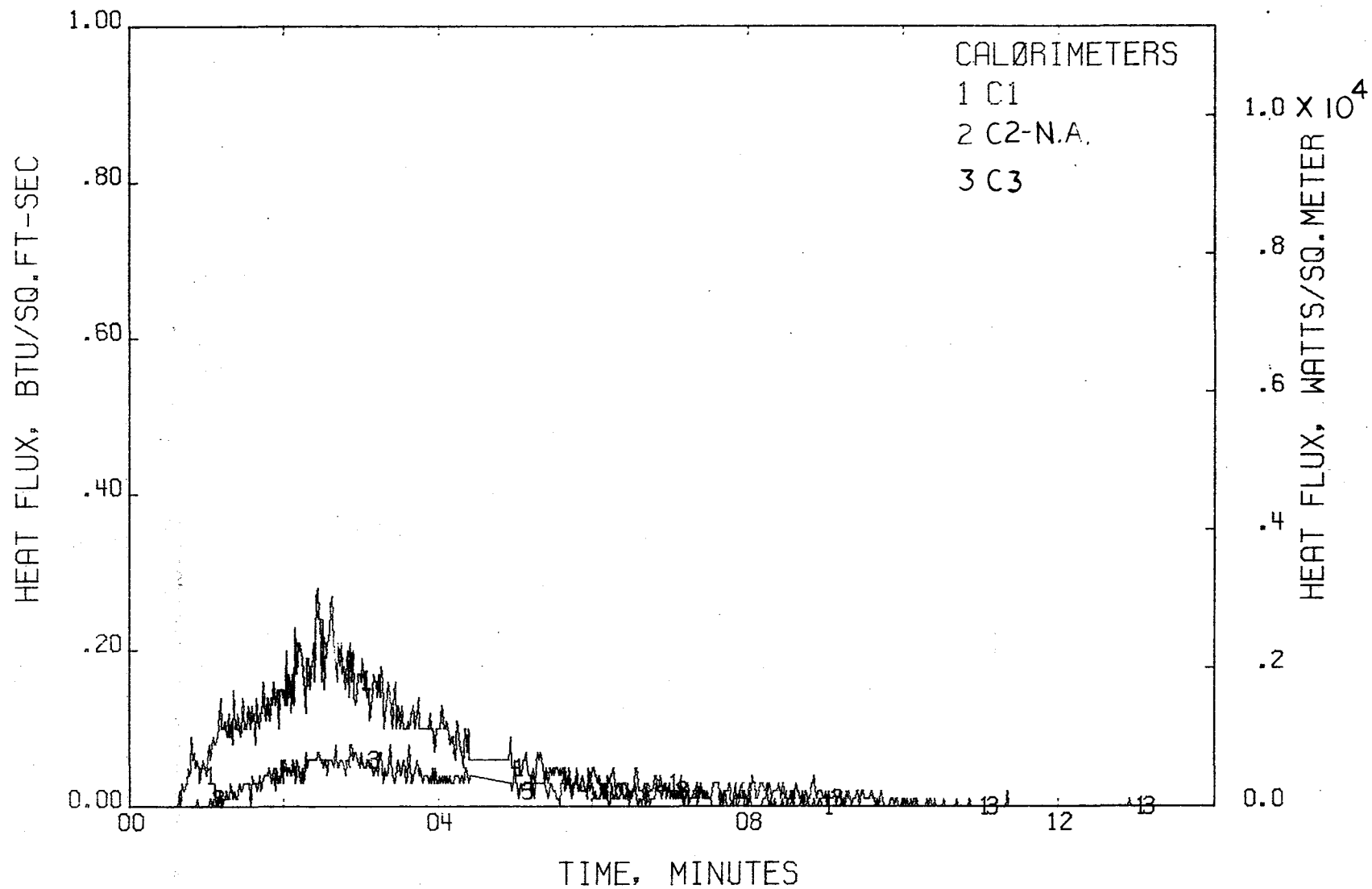


FIGURE 173 . - HEAT FLUX, AFT  
TEST 12



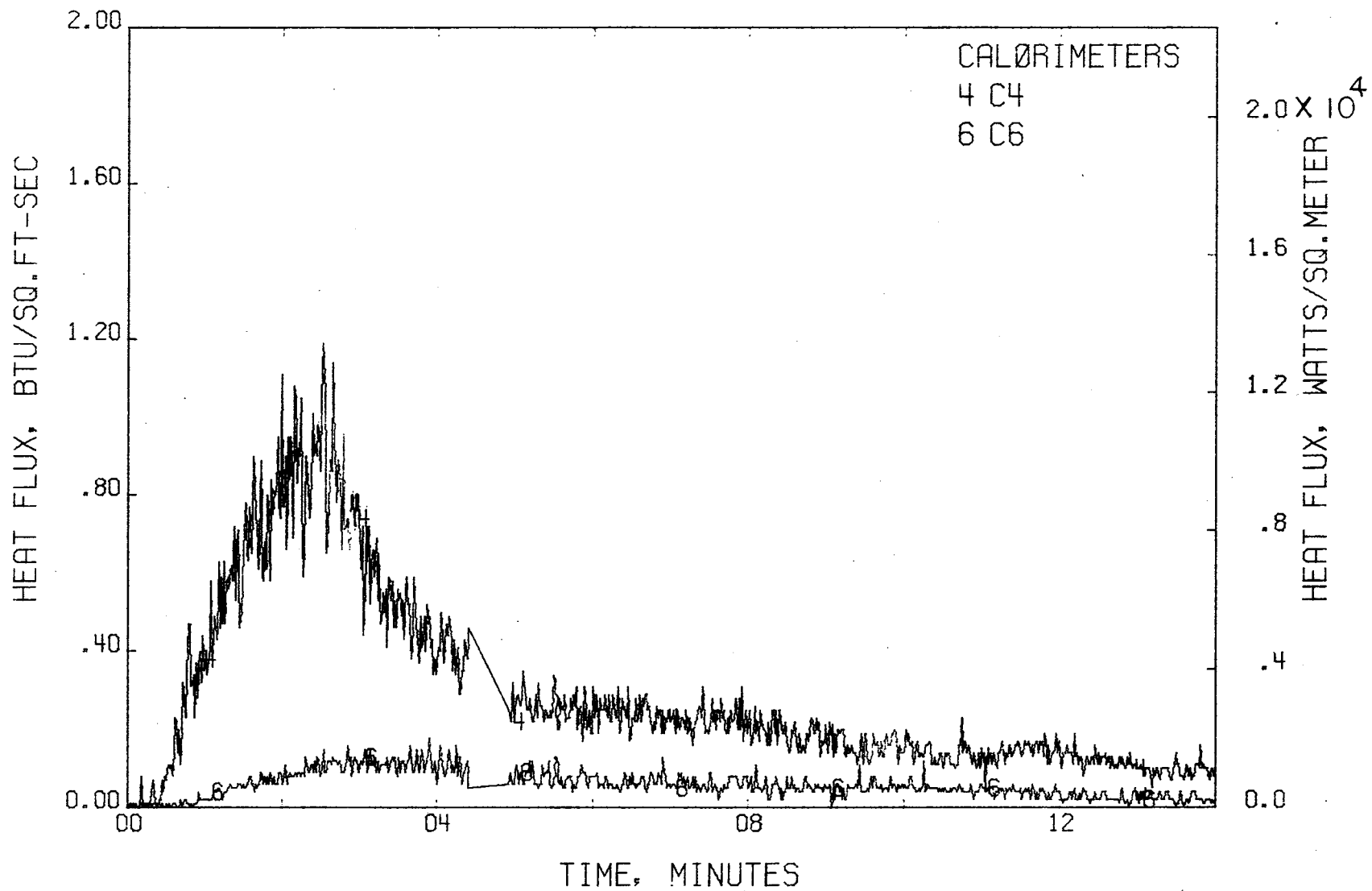


FIGURE 174 . - HEAT FLUX, MIDSECTION  
TEST 12

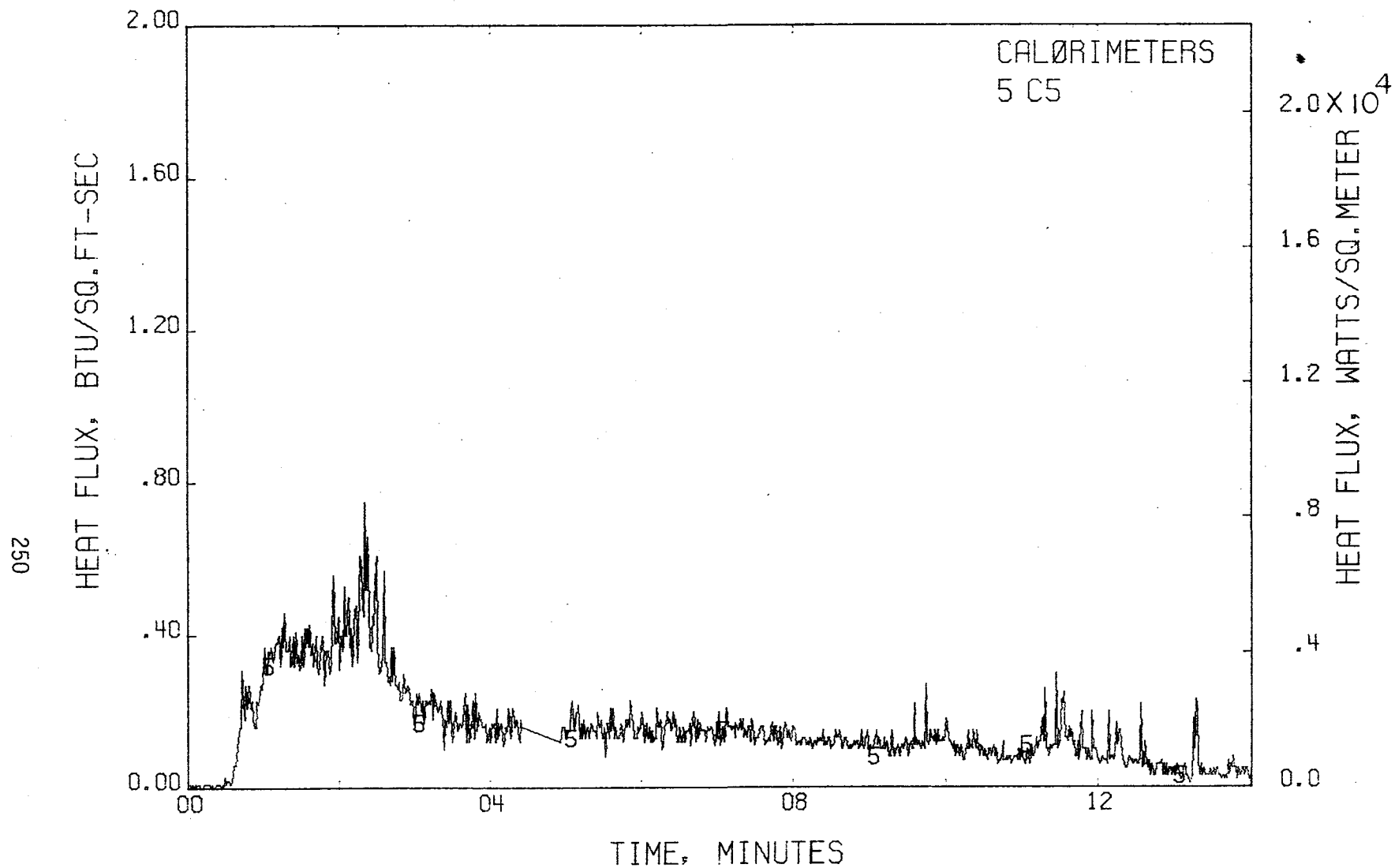


FIGURE 174 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 12

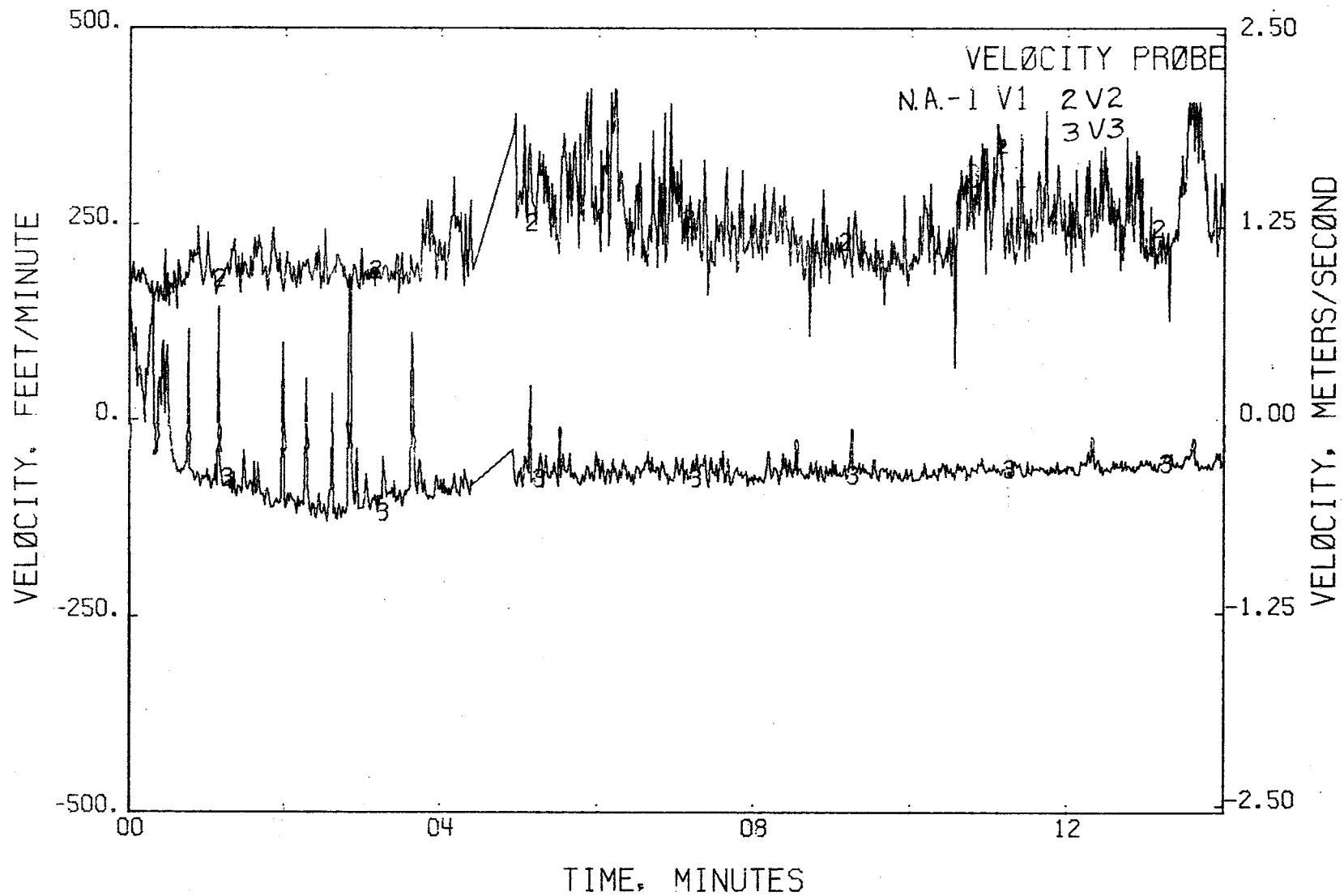


FIGURE 175 . - AIR VELOCITY  
TEST 12

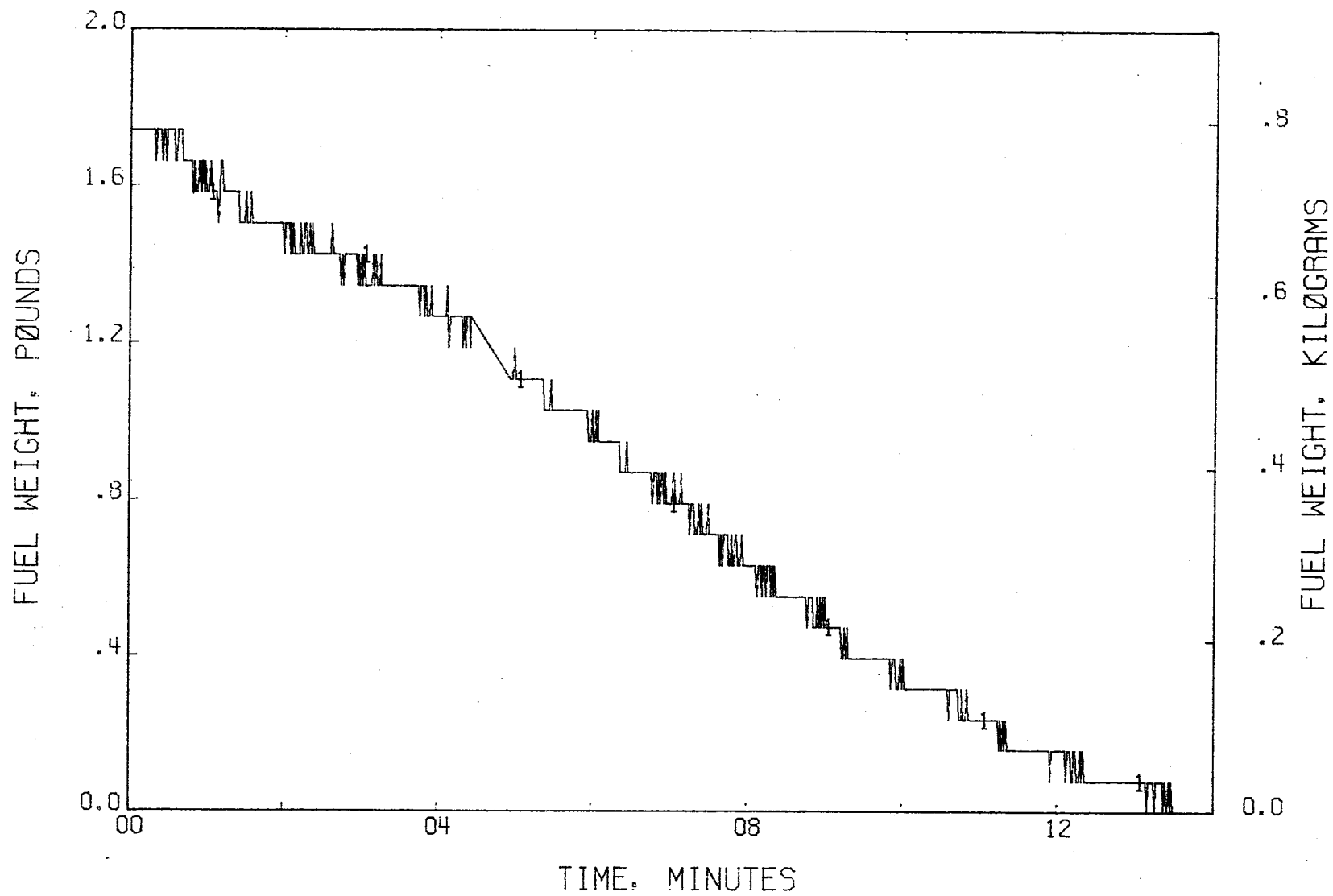


FIGURE 176 . - FUEL WEIGHT LOSS  
TEST 12

253

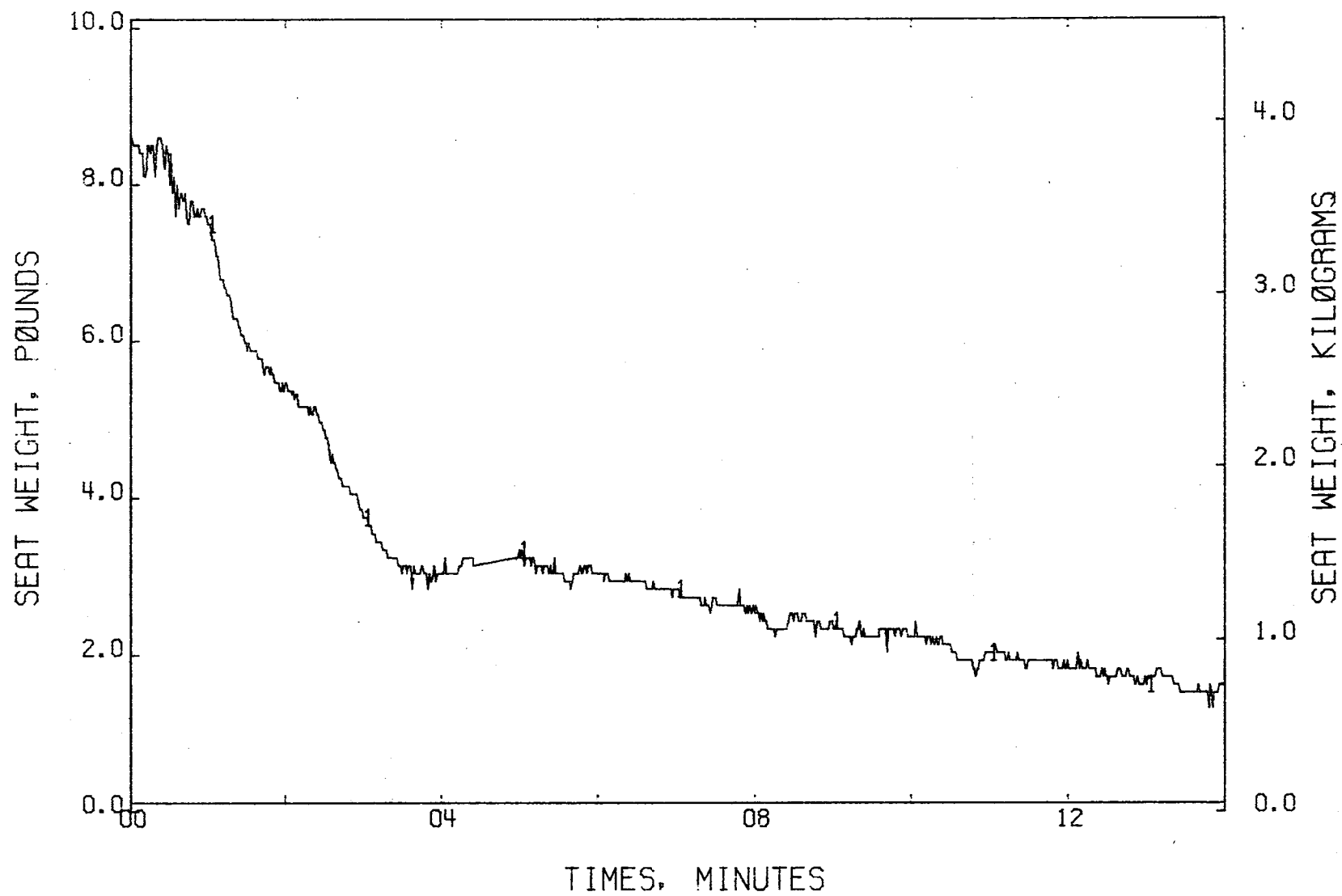


FIGURE 177 . - SEAT WEIGHT LOSS  
TEST 12

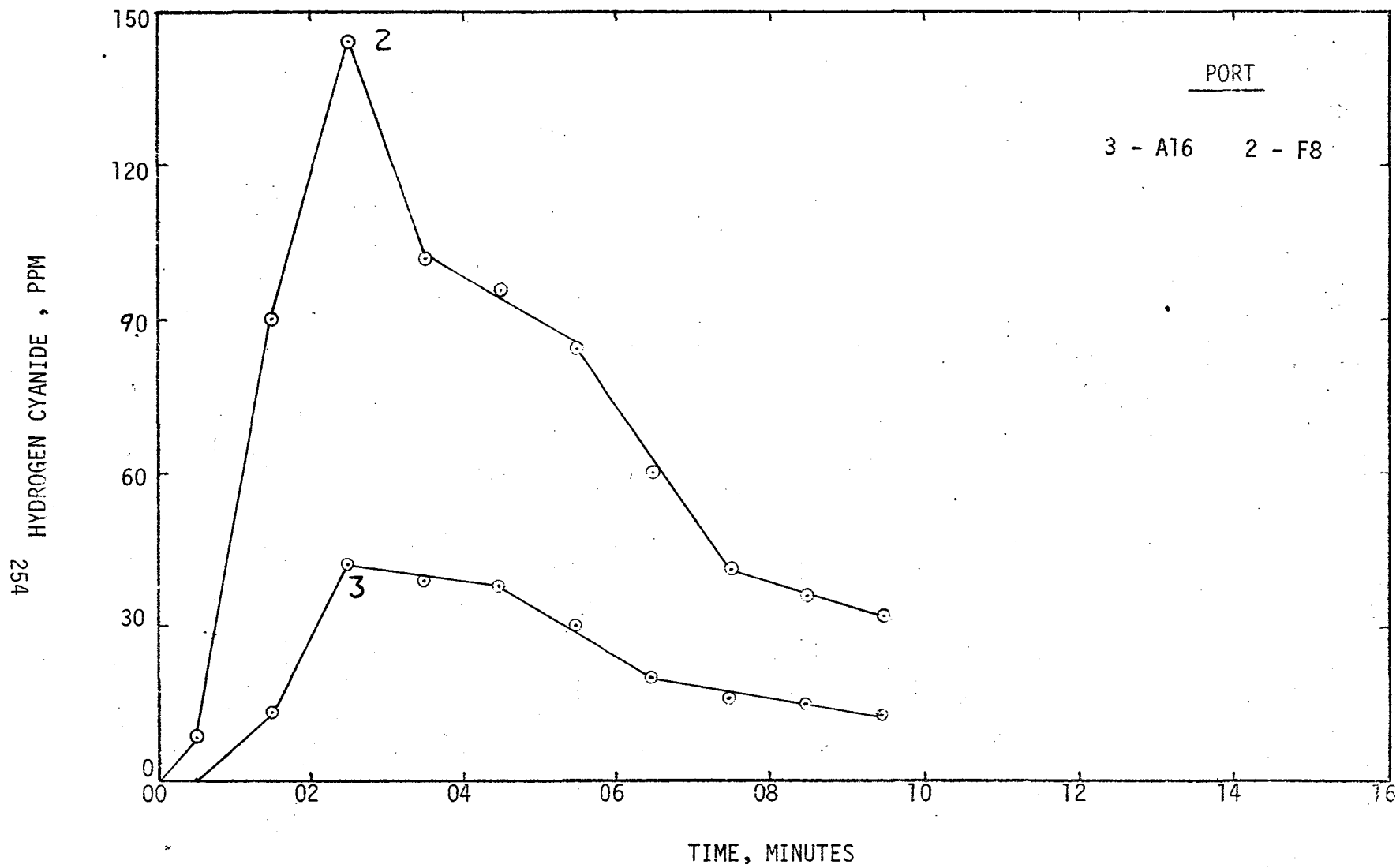


FIGURE 178 : - HYDROGEN CYANIDE CONCENTRATIONS  
TEST 12

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 6 PPM

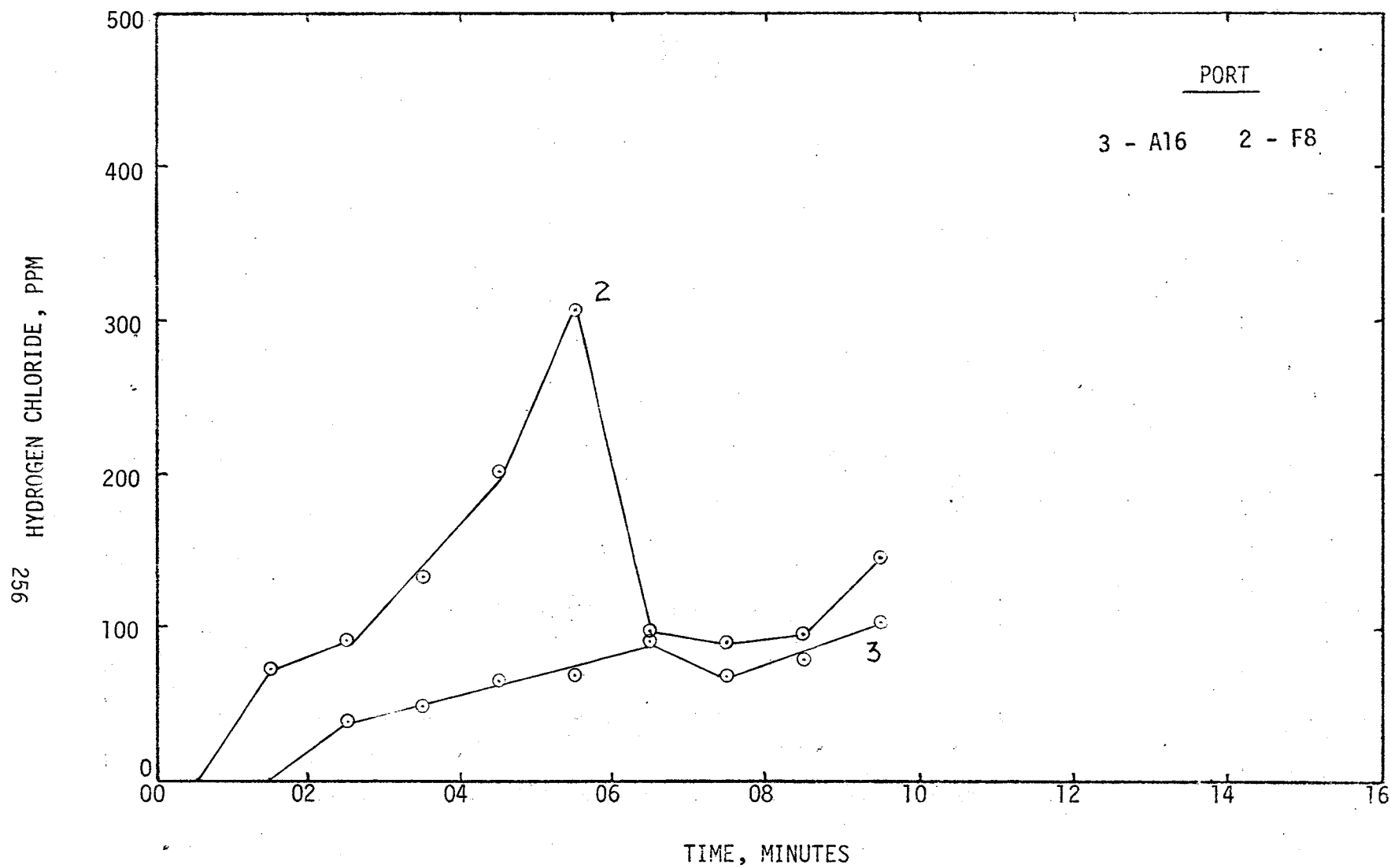


FIGURE 180 : - HYDROGEN CHLORIDE CONCENTRATIONS  
TEST 12



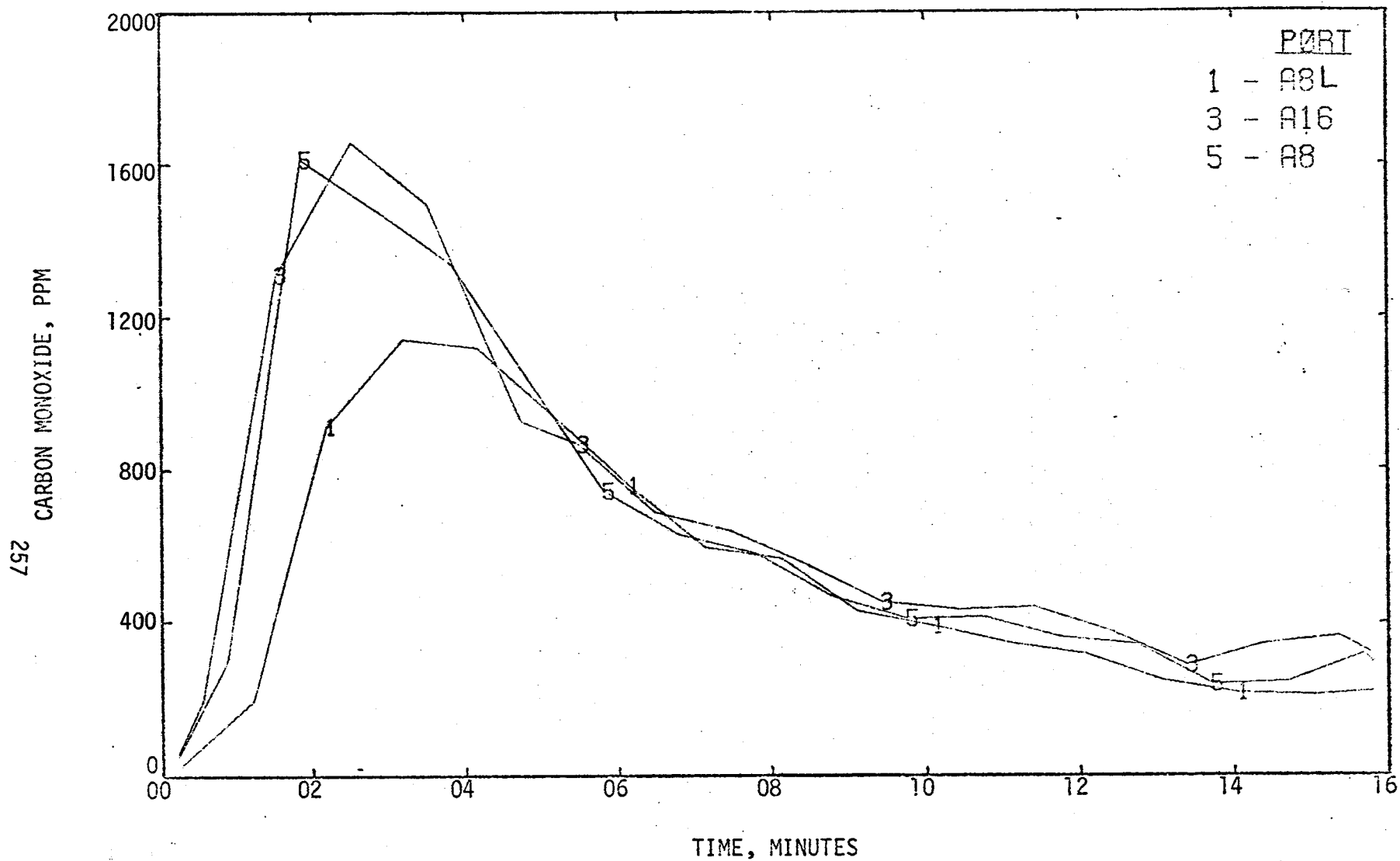


FIGURE 181 . - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 12

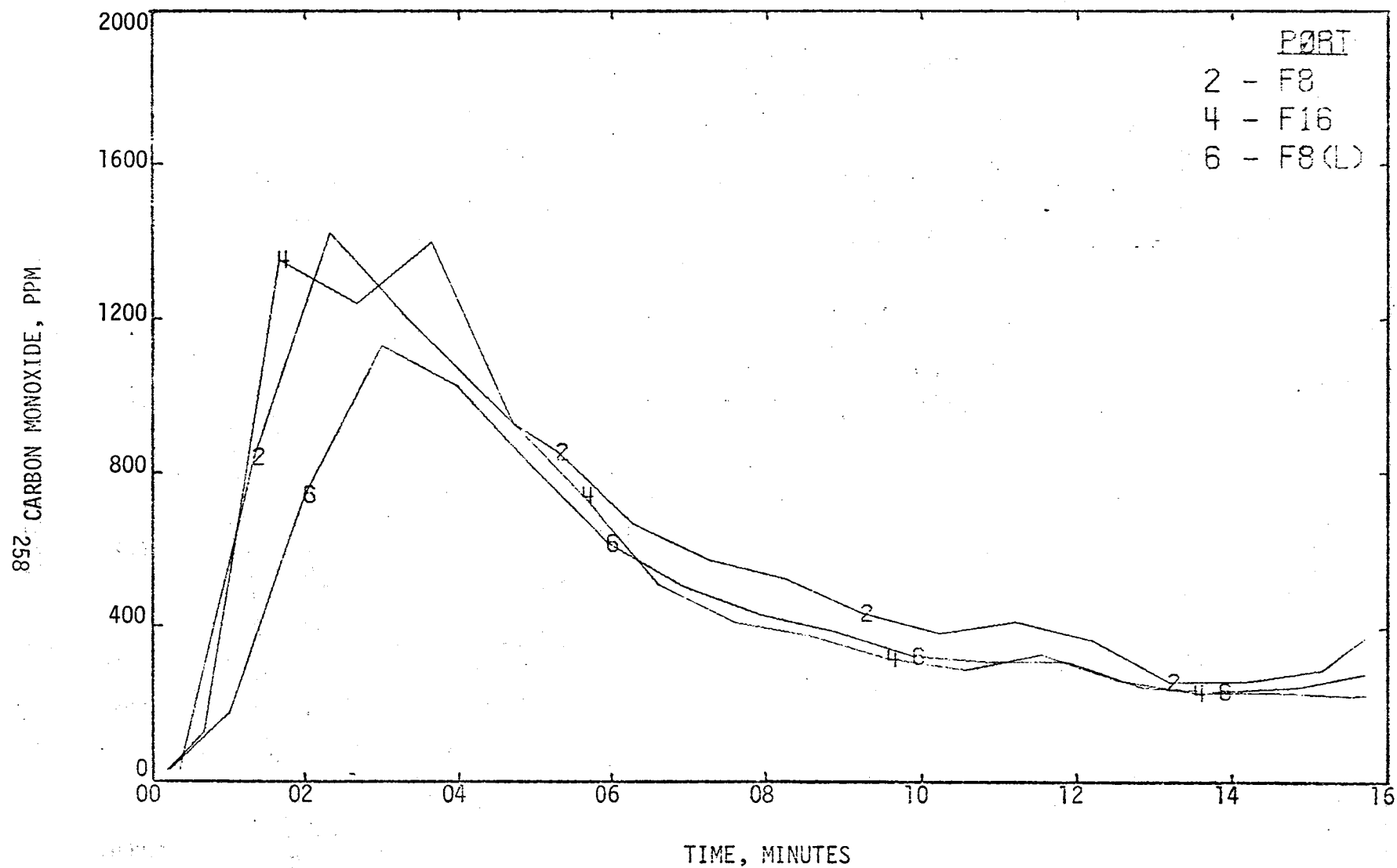


FIGURE 182 . - CARBON MONOXIDE CONCENTRATIONS, FORE  
TEST 12

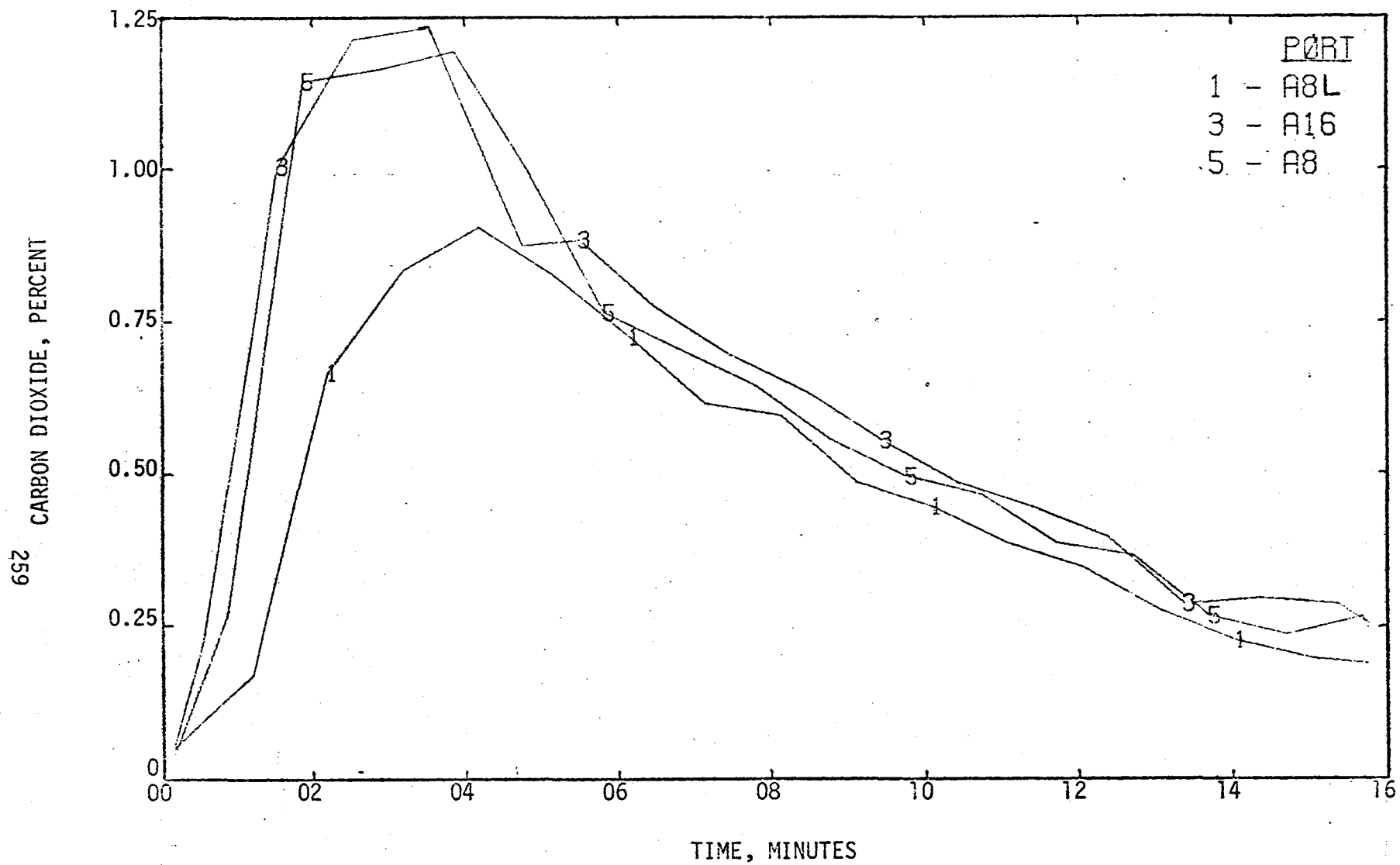


FIGURE 183 CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 12

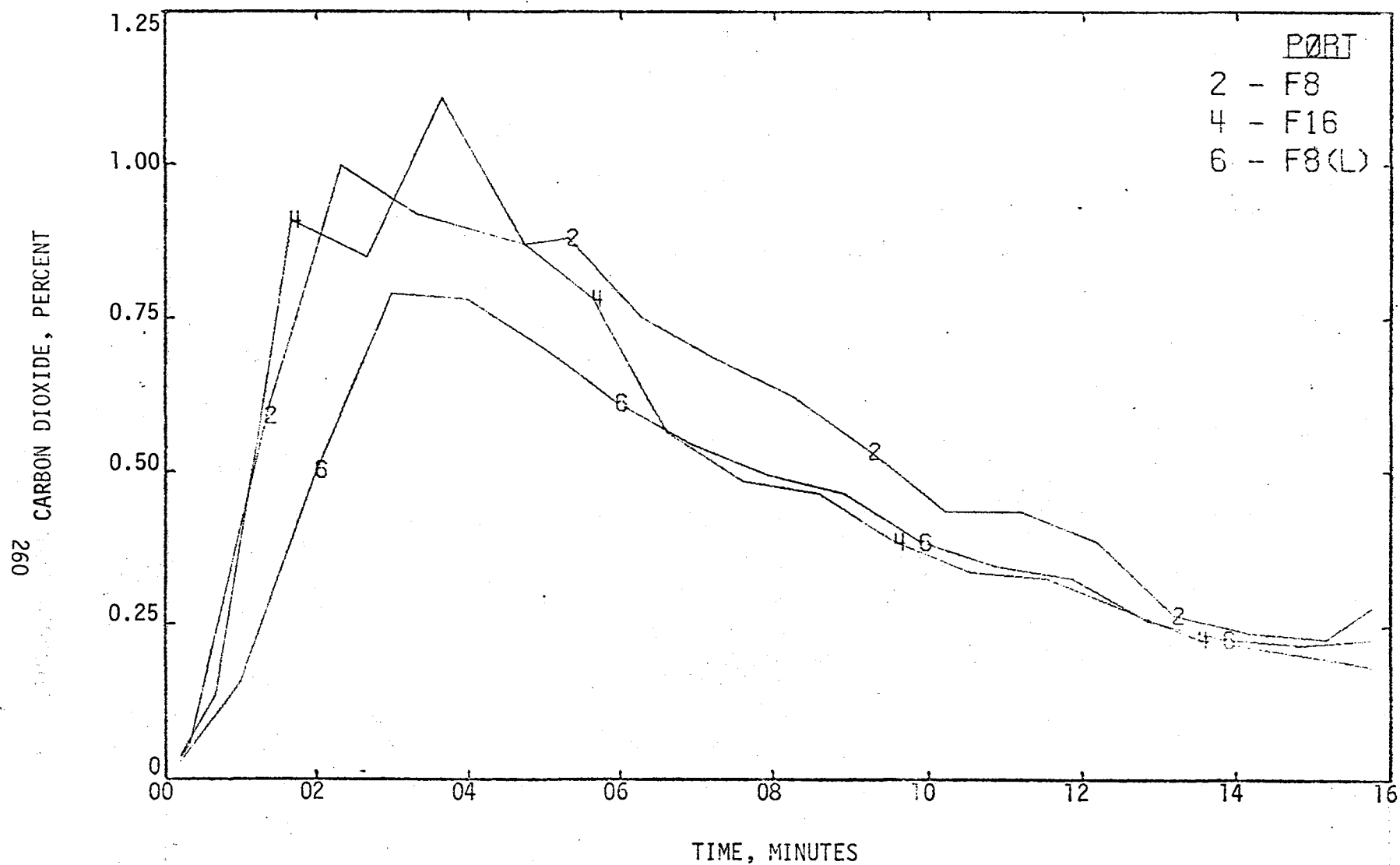


FIGURE 184 . - CARBON DIOXIDE CONCENTRATIONS, FORE  
TEST 12

261

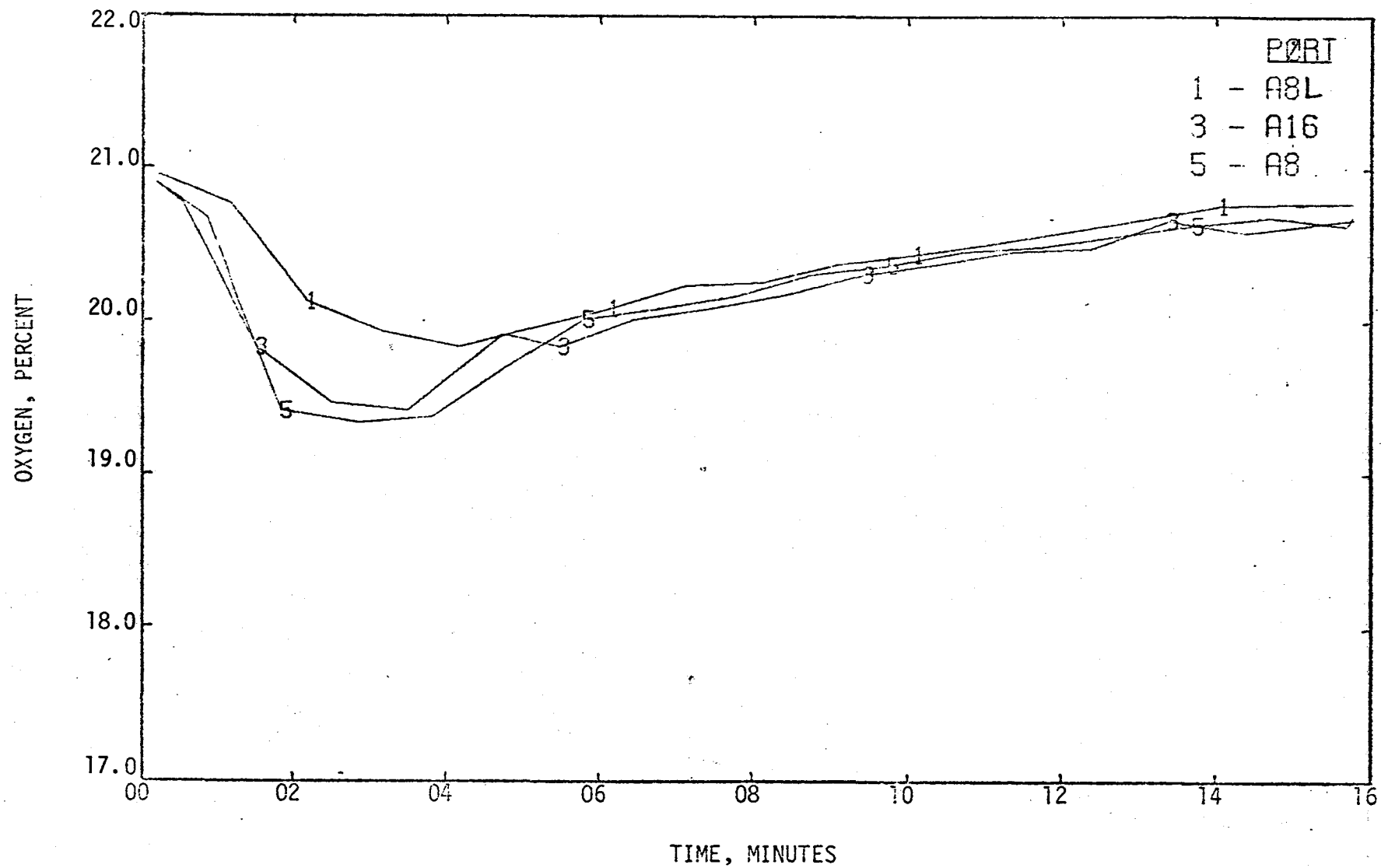


FIGURE 185 . - OXYGEN CONCENTRATIONS, AFT  
TEST 12

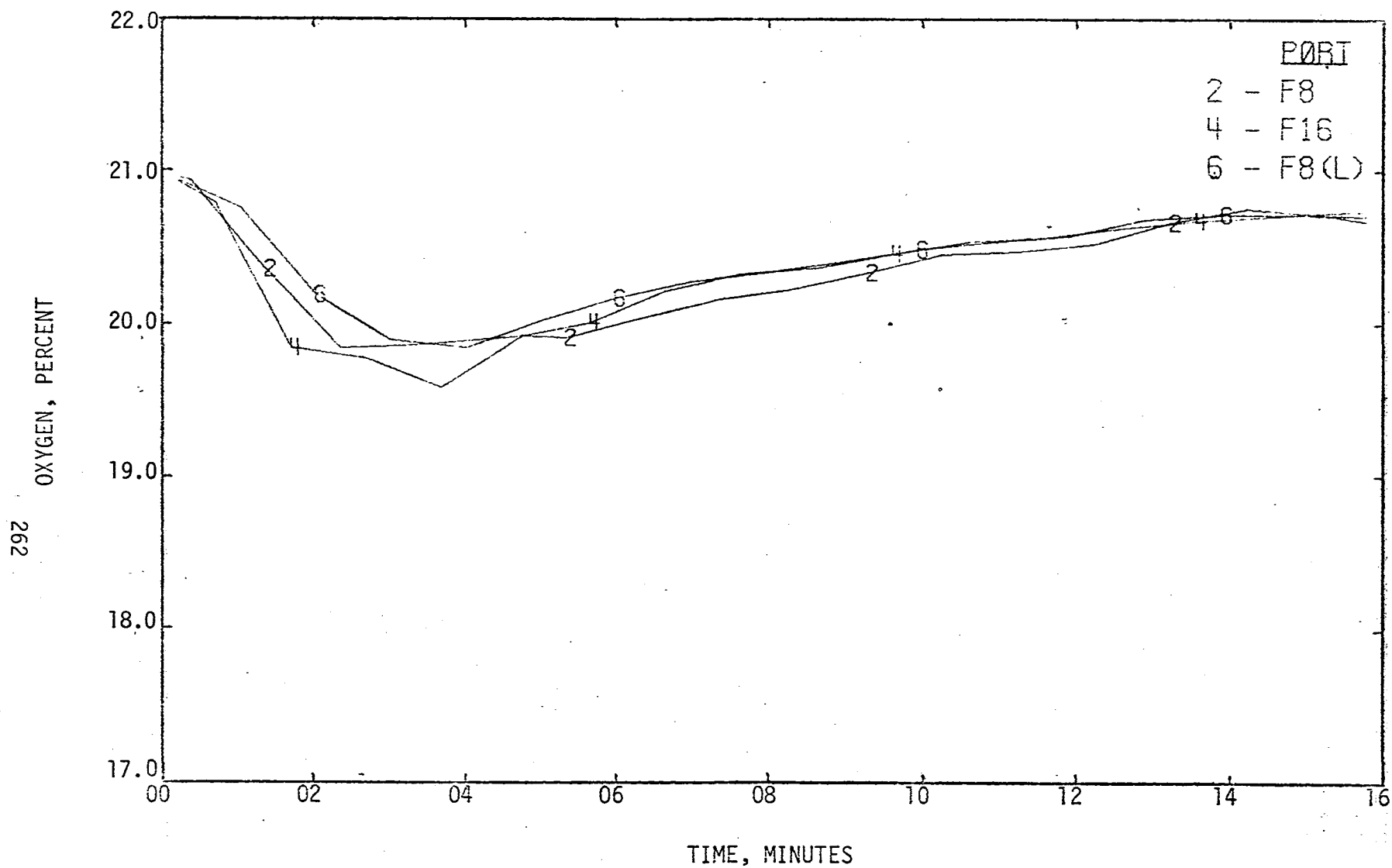


FIGURE 186 - OXYGEN CONCENTRATIONS, FORE  
TEST 12

263

HYDROCARBONS, PPM

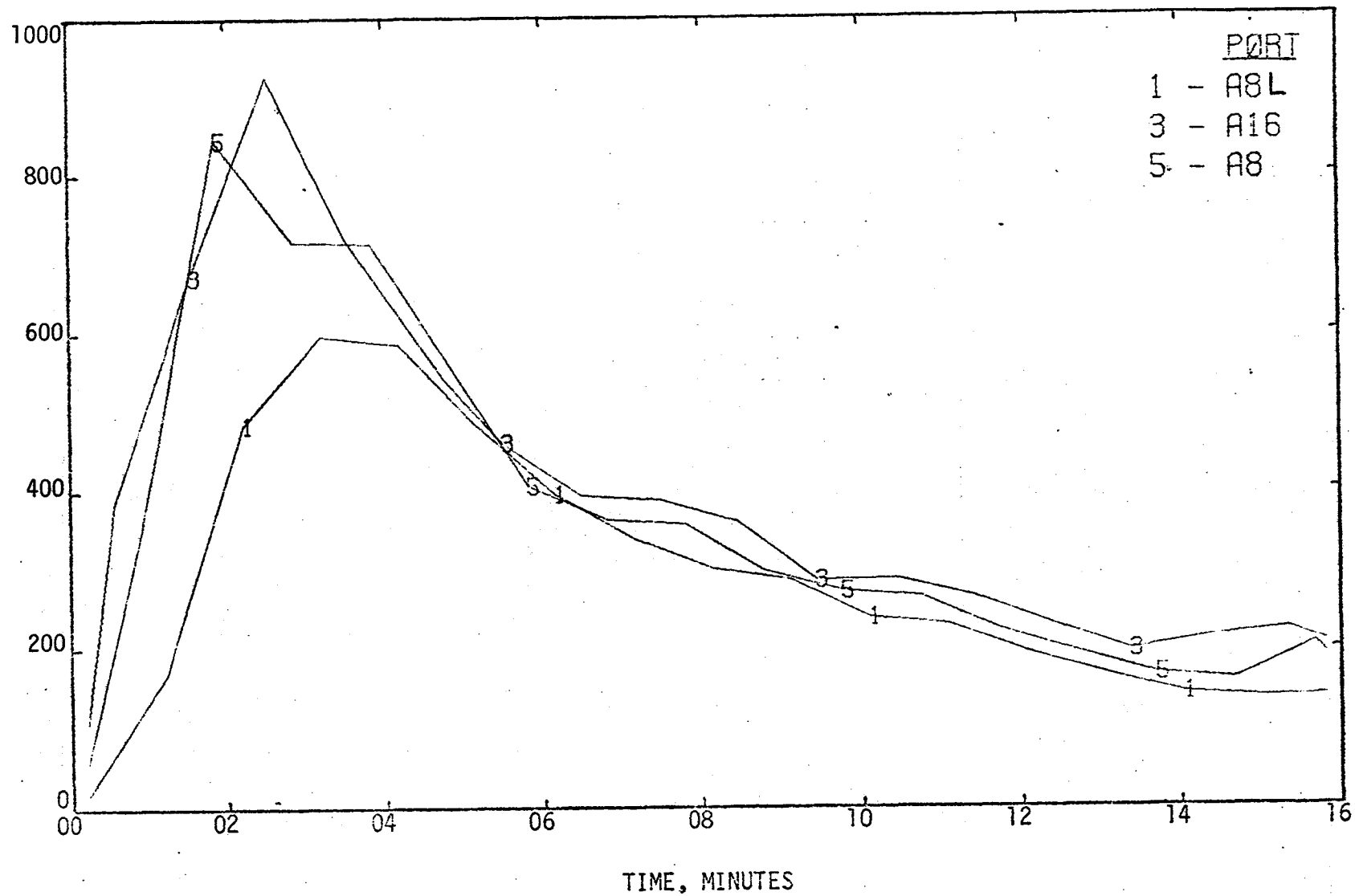


FIGURE 187 - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 12

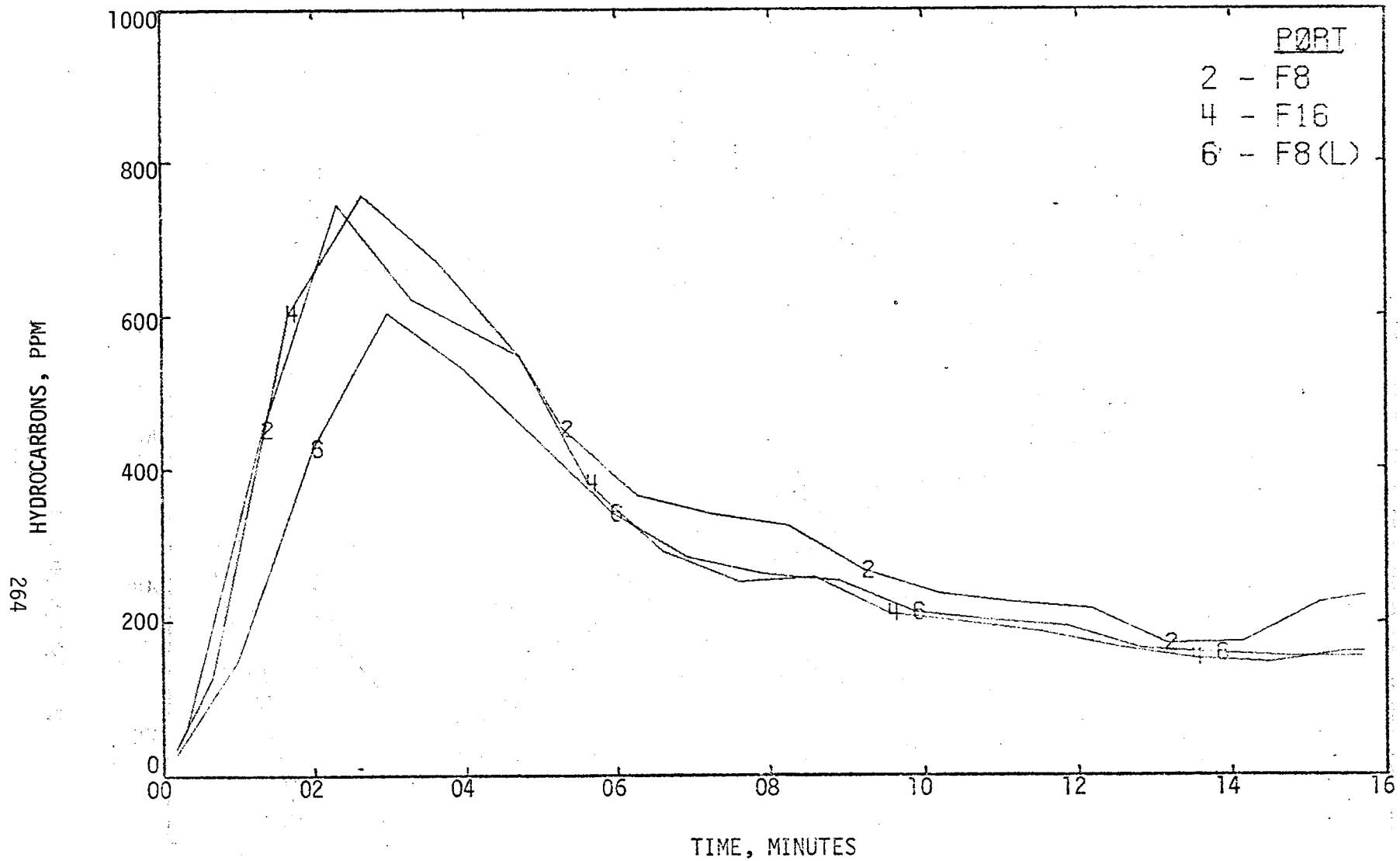


FIGURE 188 - HYDROCARBONS CONCENTRATIONS, FORE  
TEST 12



TEST 13

---

BARE URETHANE FOAM SEATS (BACKS ONLY)

TEST 13

BARE URETHANE FOAM SEATS (BACKS ONLY)

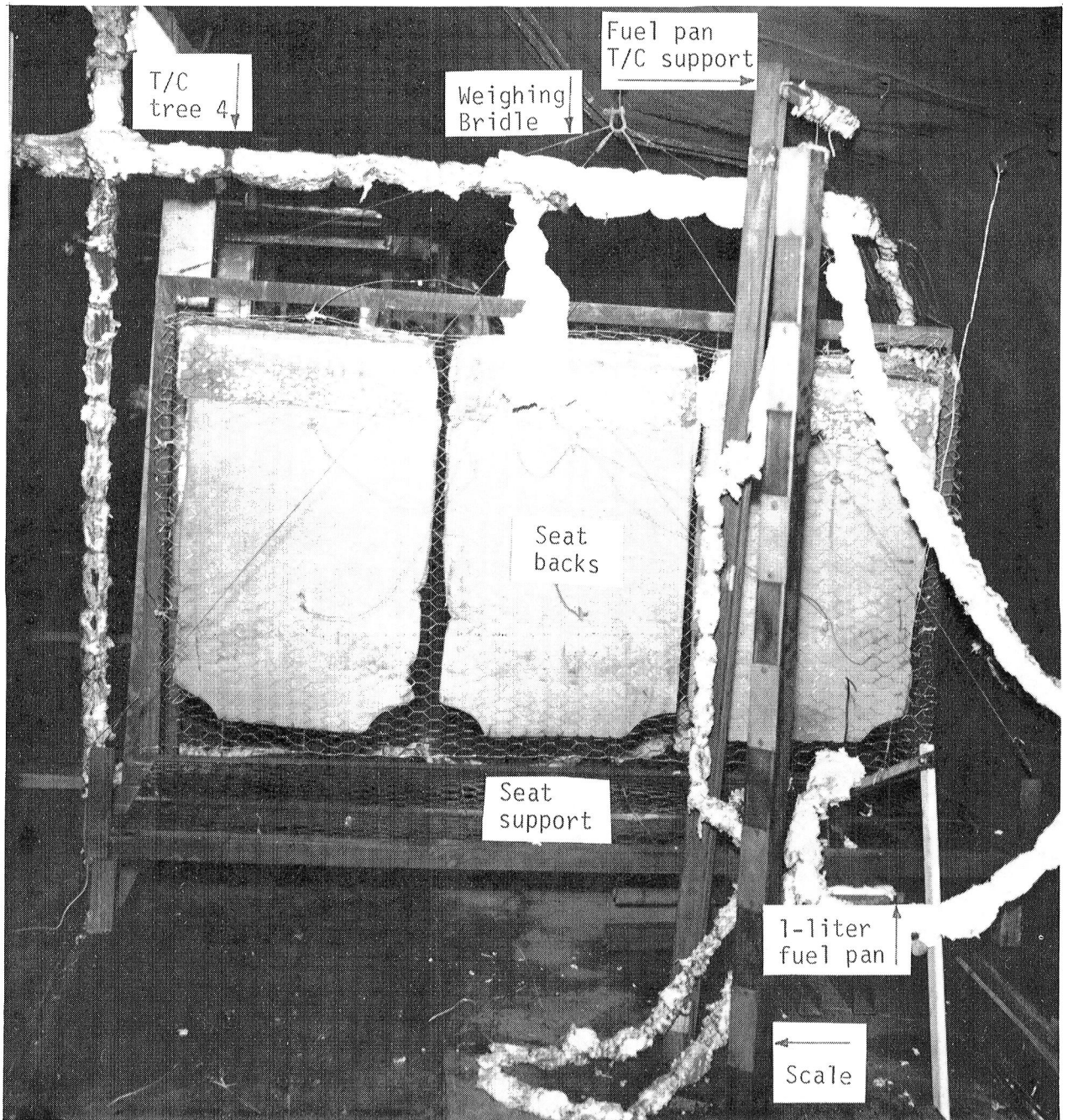


FIGURE 189 . - PRE-TEST CONFIGURATION, TEST 13

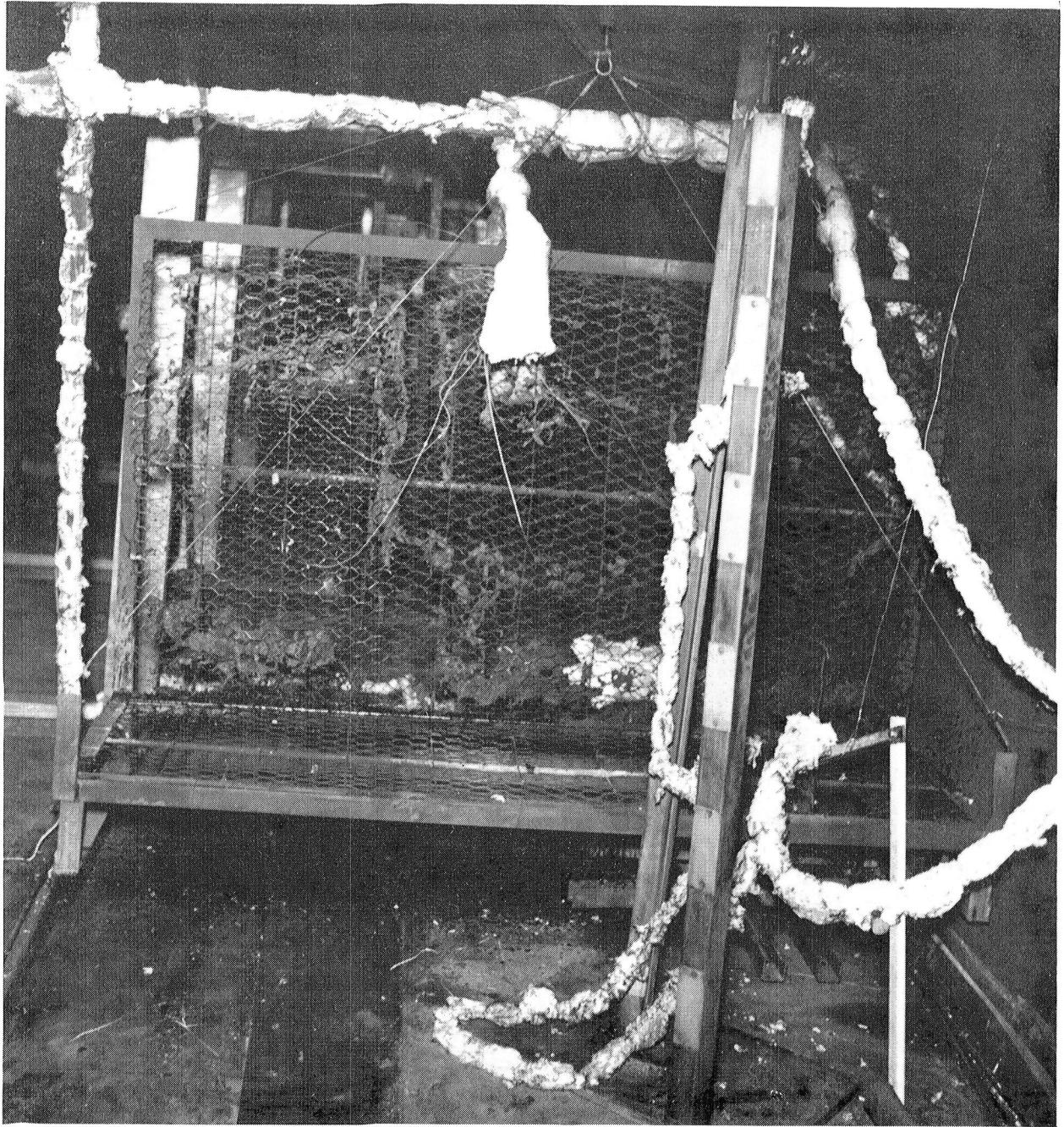


FIGURE 190 - POST-TEST CONFIGURATION, TEST 13





FIGURE 191 . - FIRE DURING TEST 13

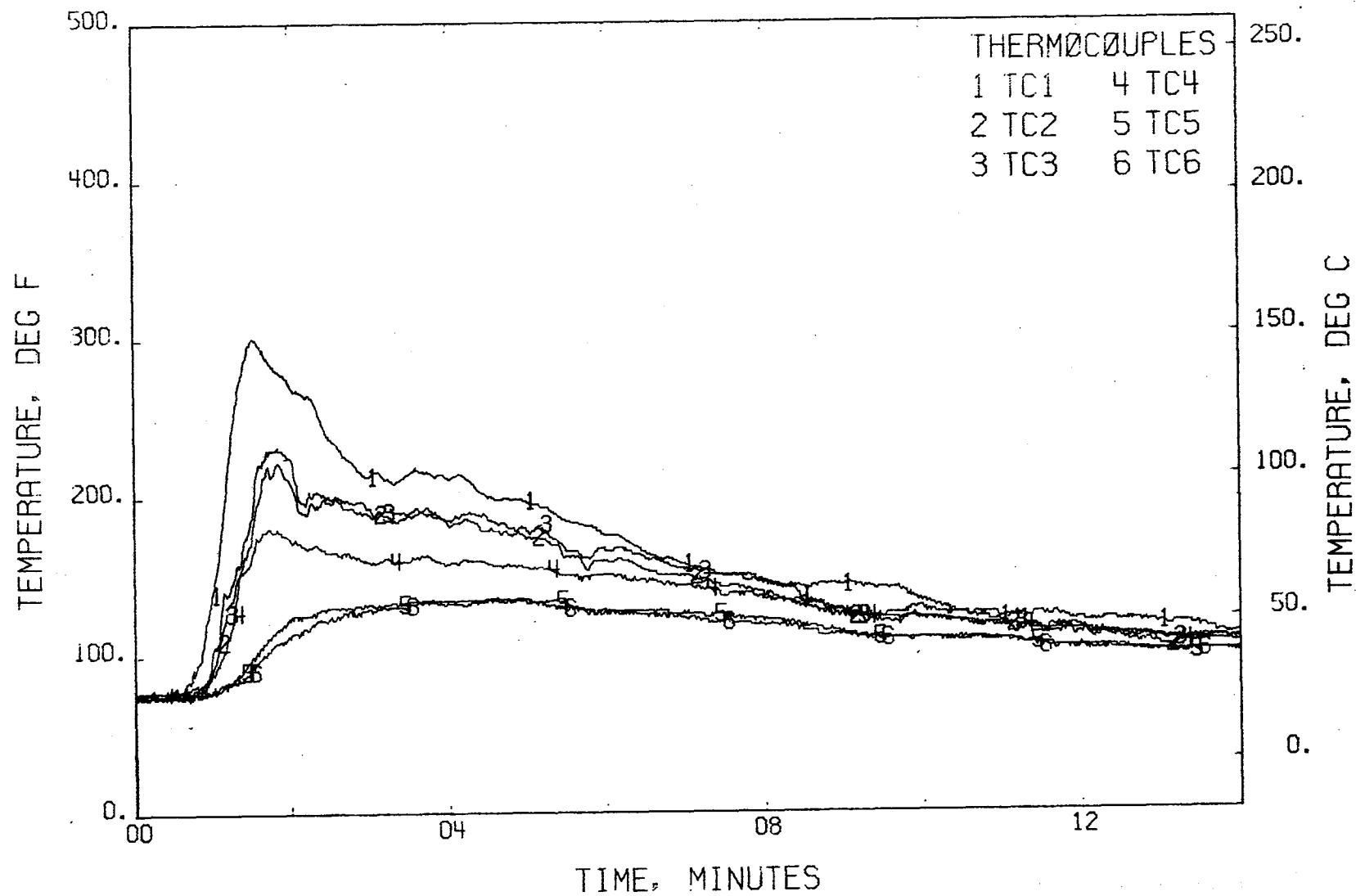


FIGURE 192 . - TEMPERATURES, T/C TREE 1  
TEST 13

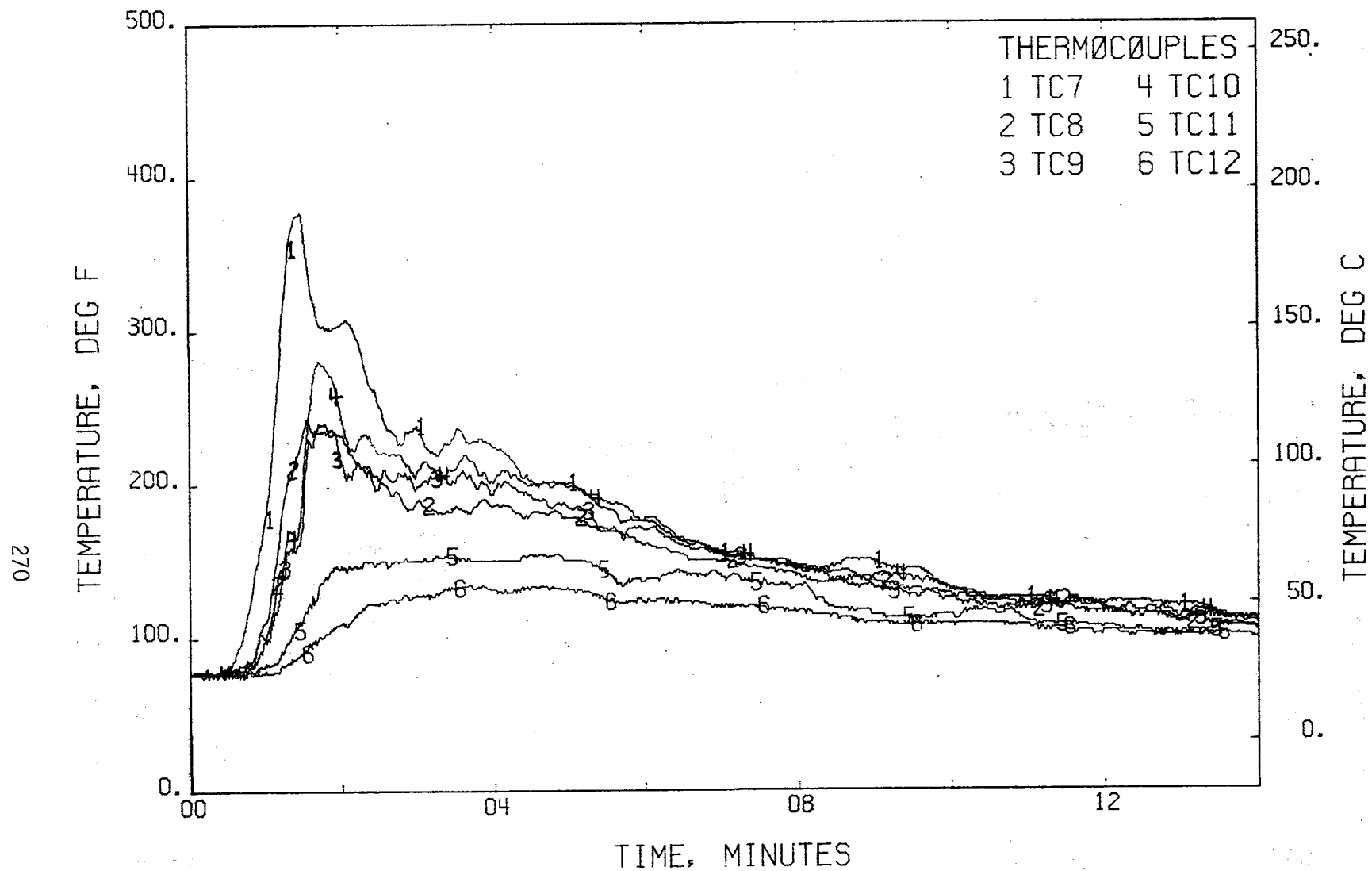


FIGURE 193 . - TEMPERATURES, T/C TREE 2  
TEST 13

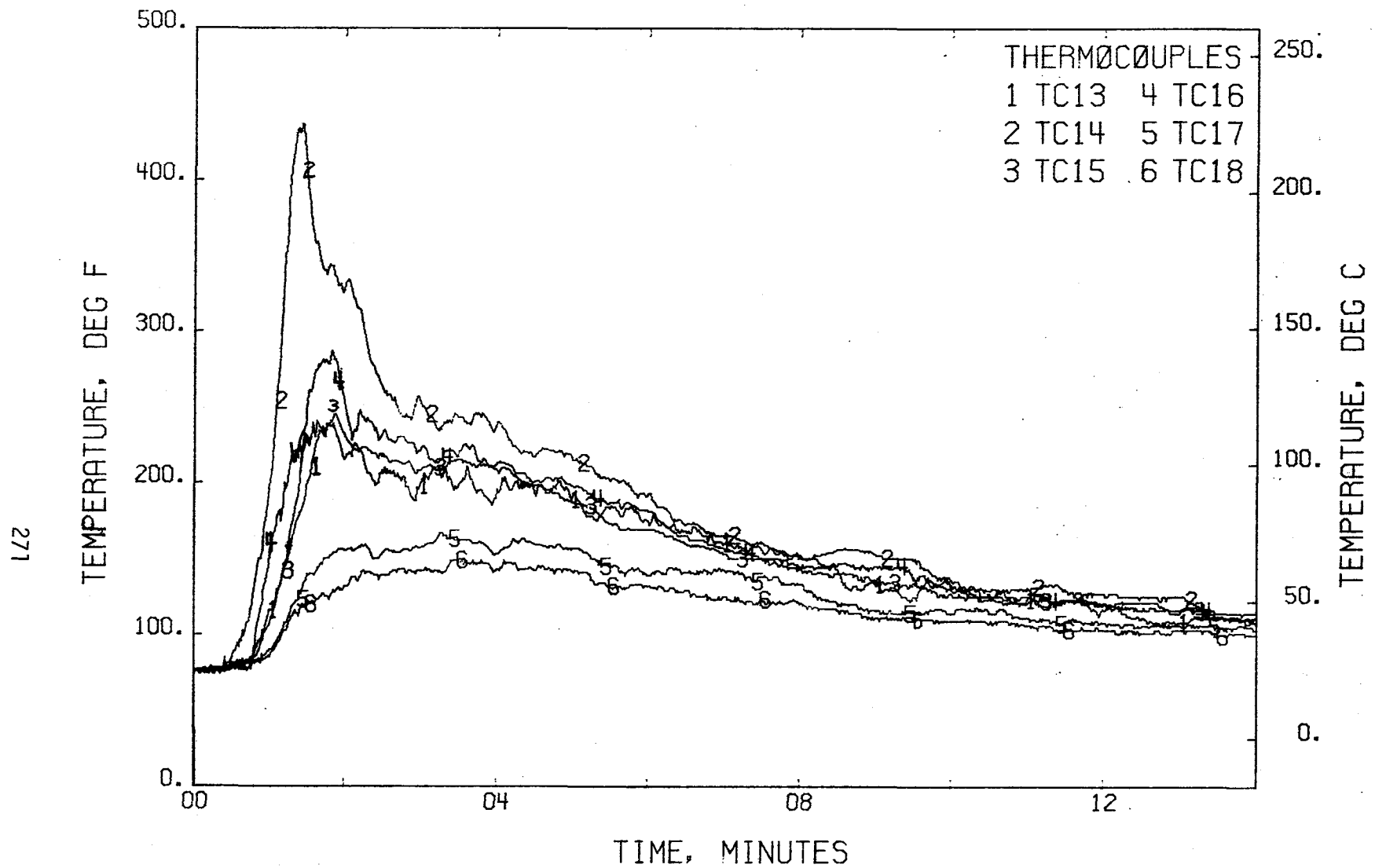


FIGURE 194 . - TEMPERATURES, T/C TREE 3  
TEST 13

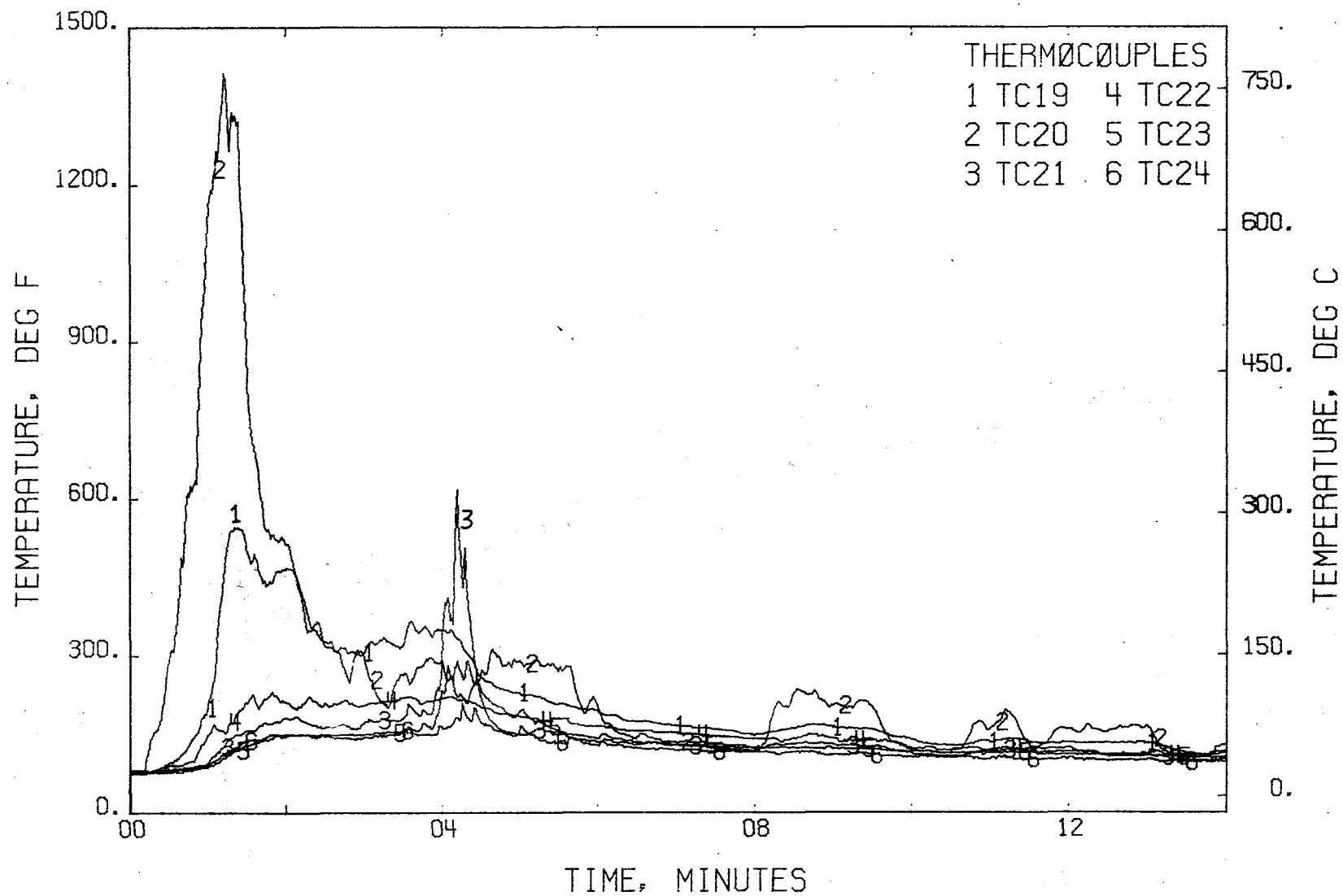


FIGURE 195 . - TEMPERATURES, T/C TREE 4  
TEST 13



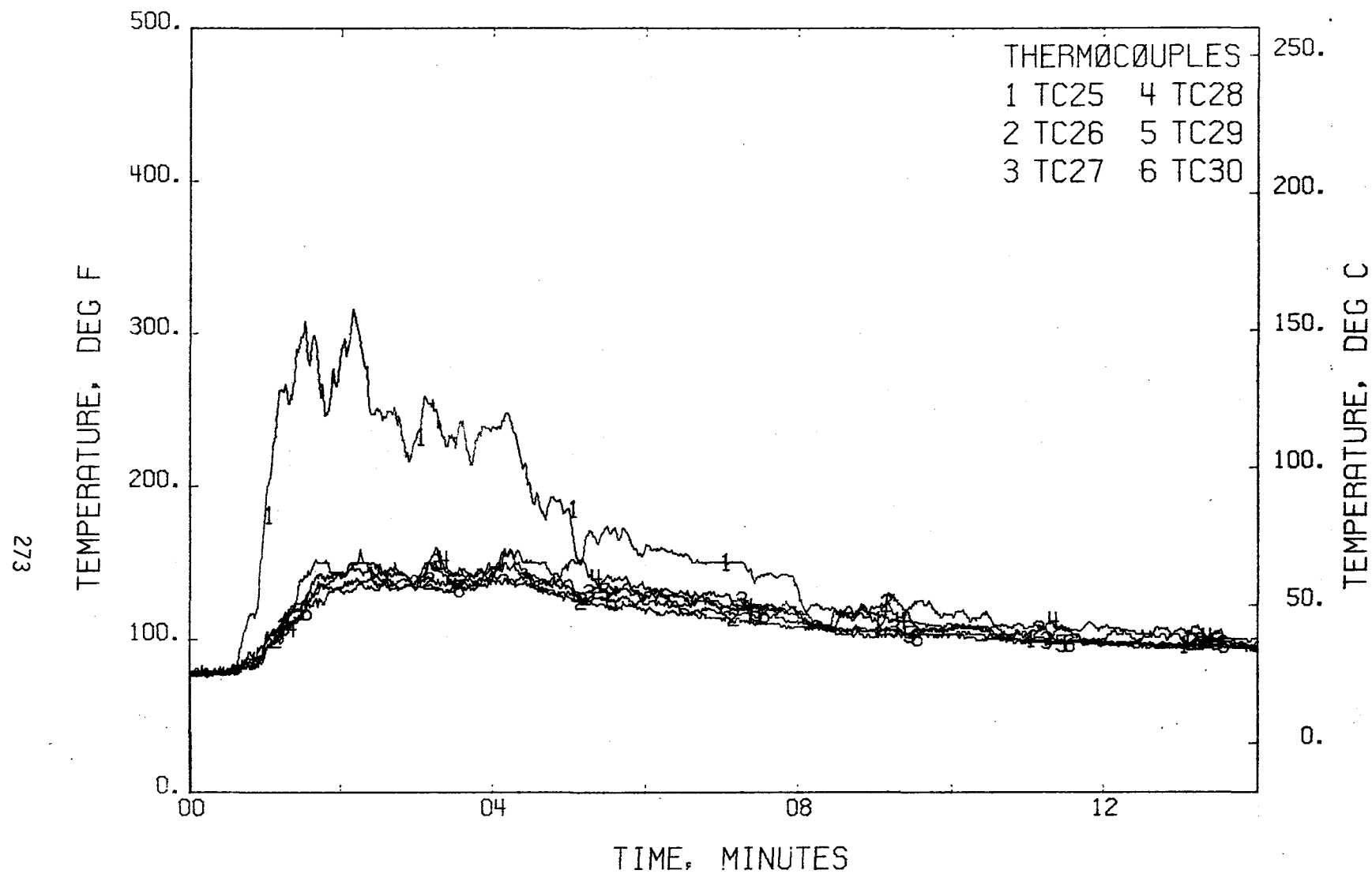


FIGURE 196 . - TEMPERATURES, T/C TREE 5  
TEST 13

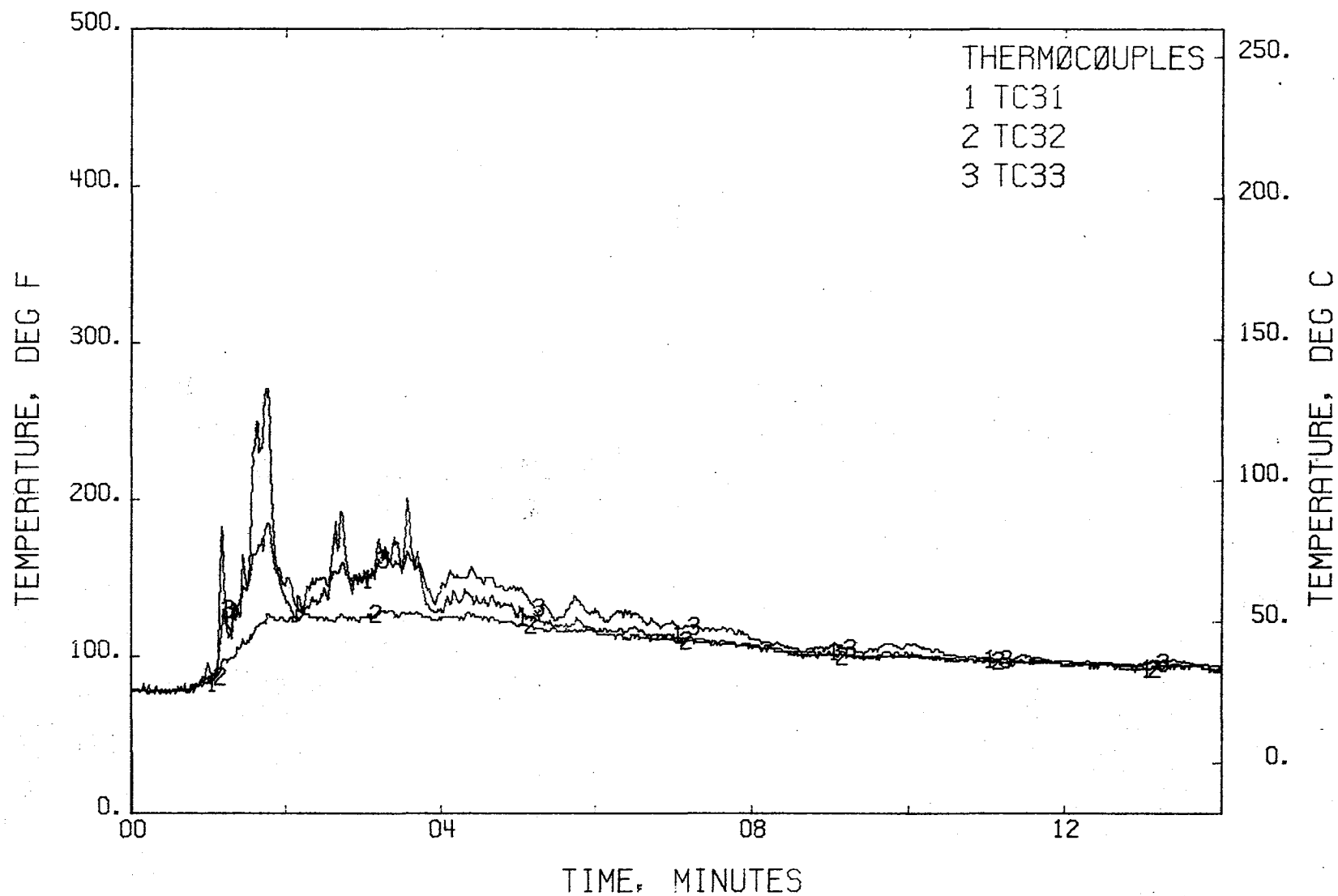


FIGURE 197 . - TEMPERATURES, T/C TREE 6  
TEST 13

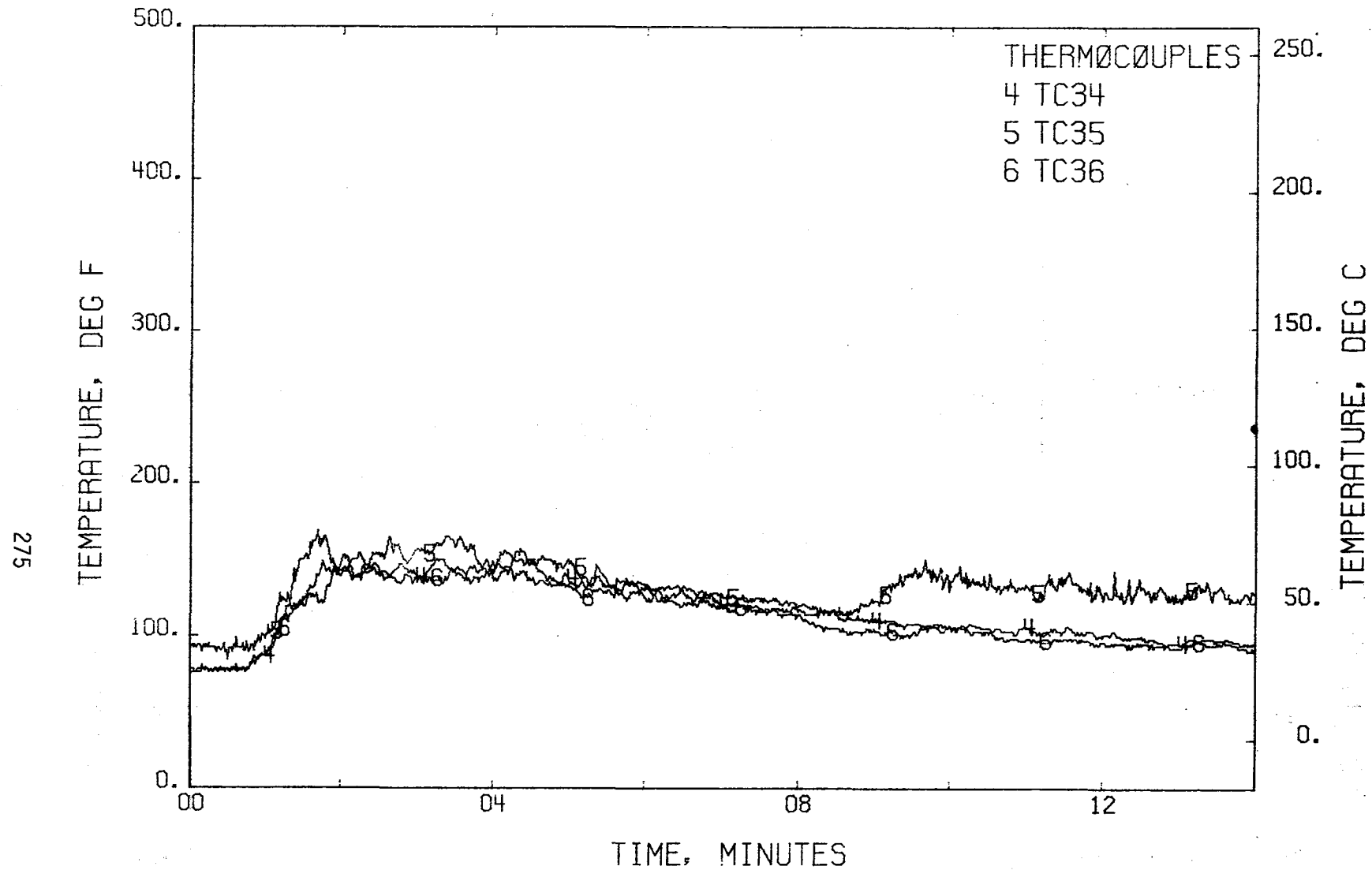


FIGURE 197 . - TEMPERATURES, T/C TREE 6-CONT.  
TEST 13

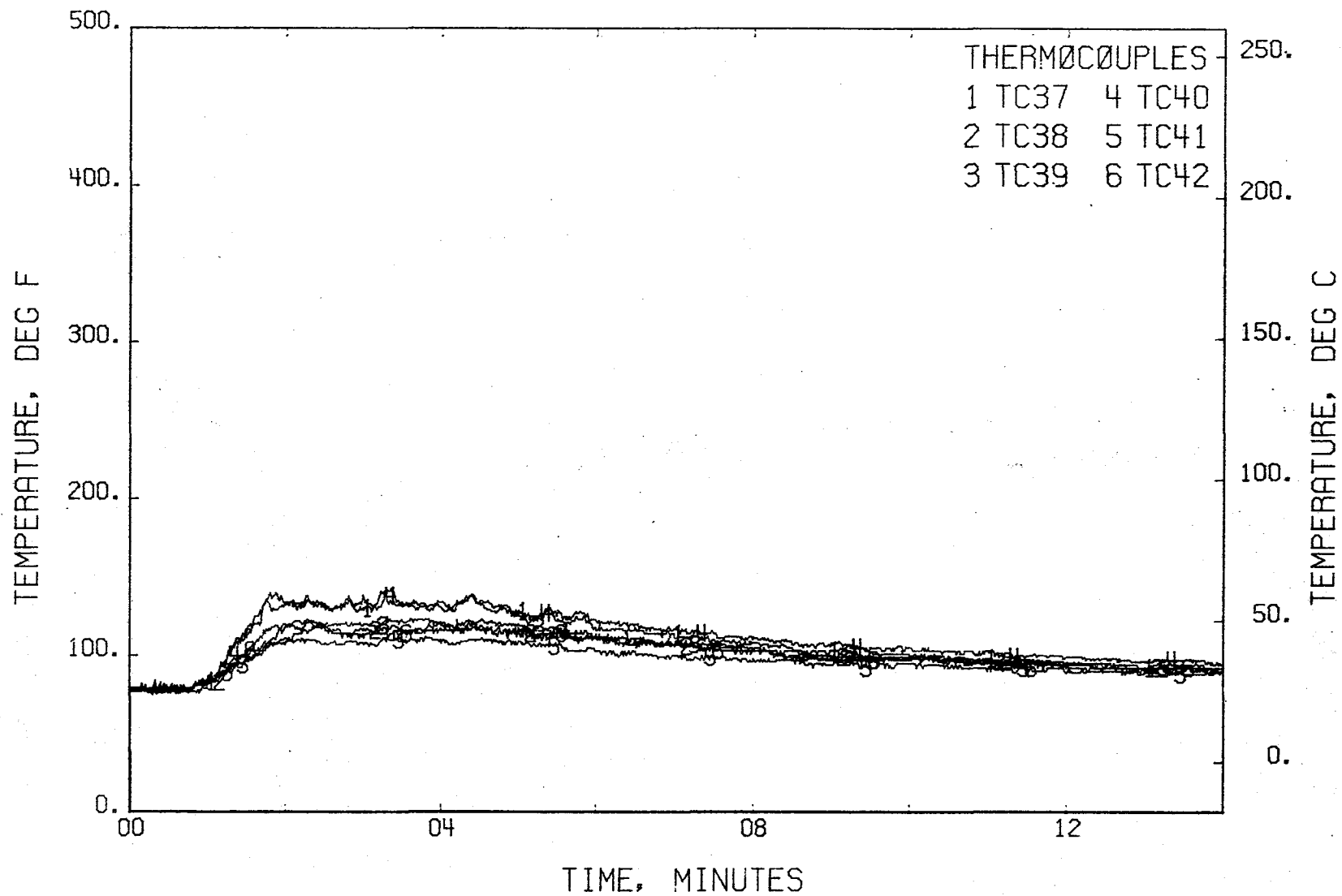


FIGURE 198 . - TEMPERATURES, T/C TREE 7  
TEST 13

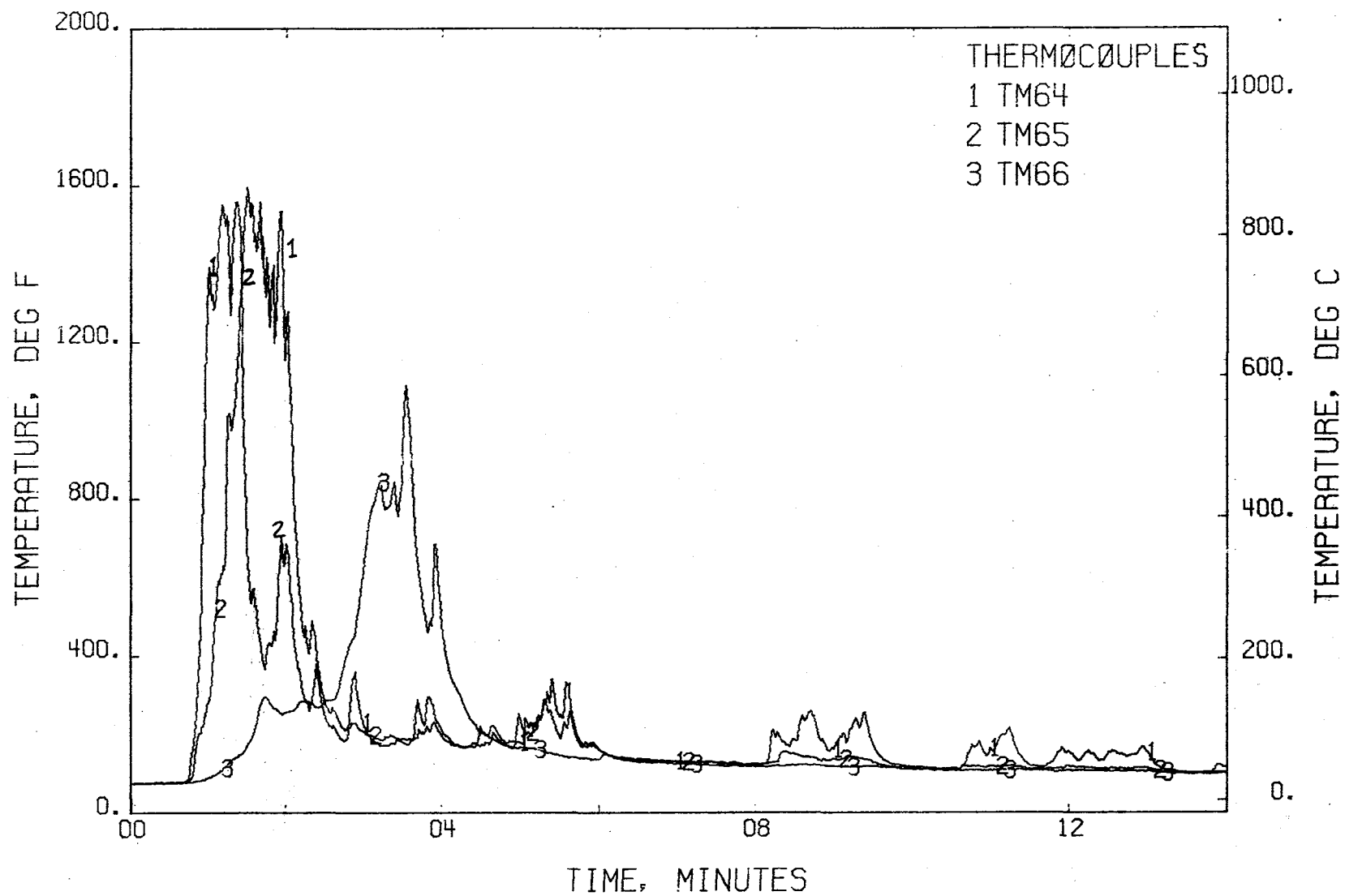


FIGURE 199 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 13

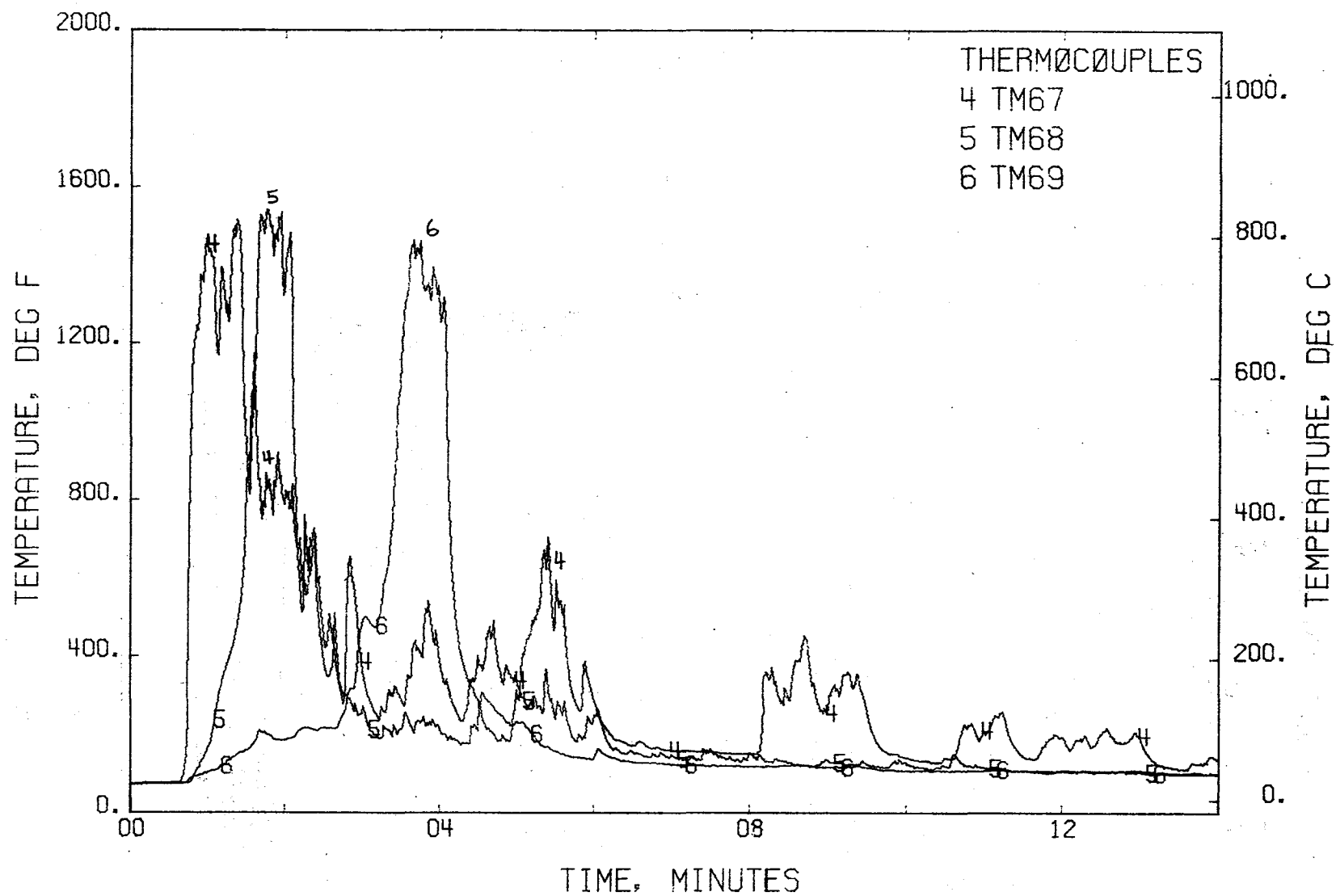


FIGURE 199 . - TEMPERATURES, SEAT BACKS (REAR)- CONT.  
TEST 13

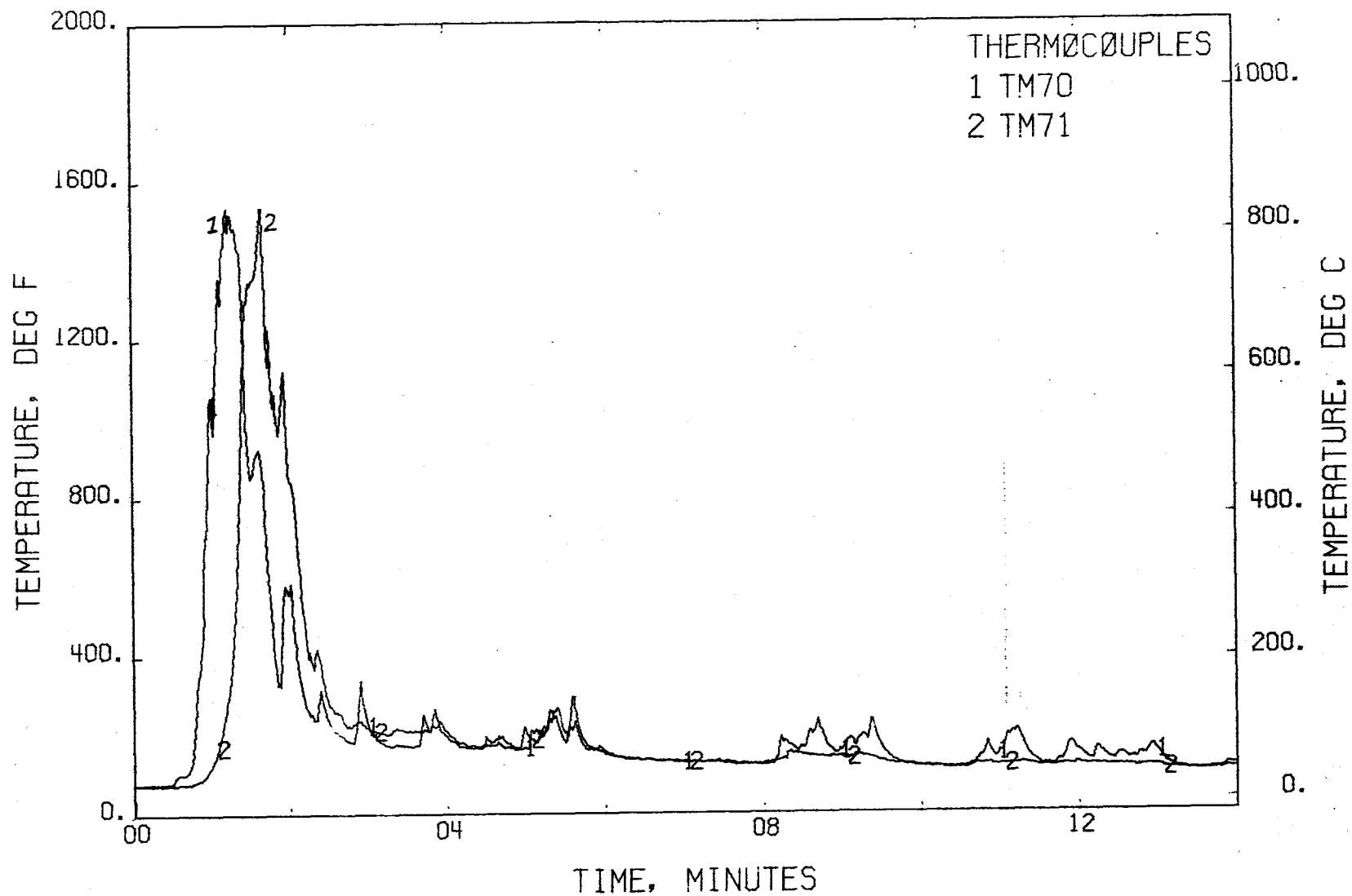


FIGURE 200 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 13

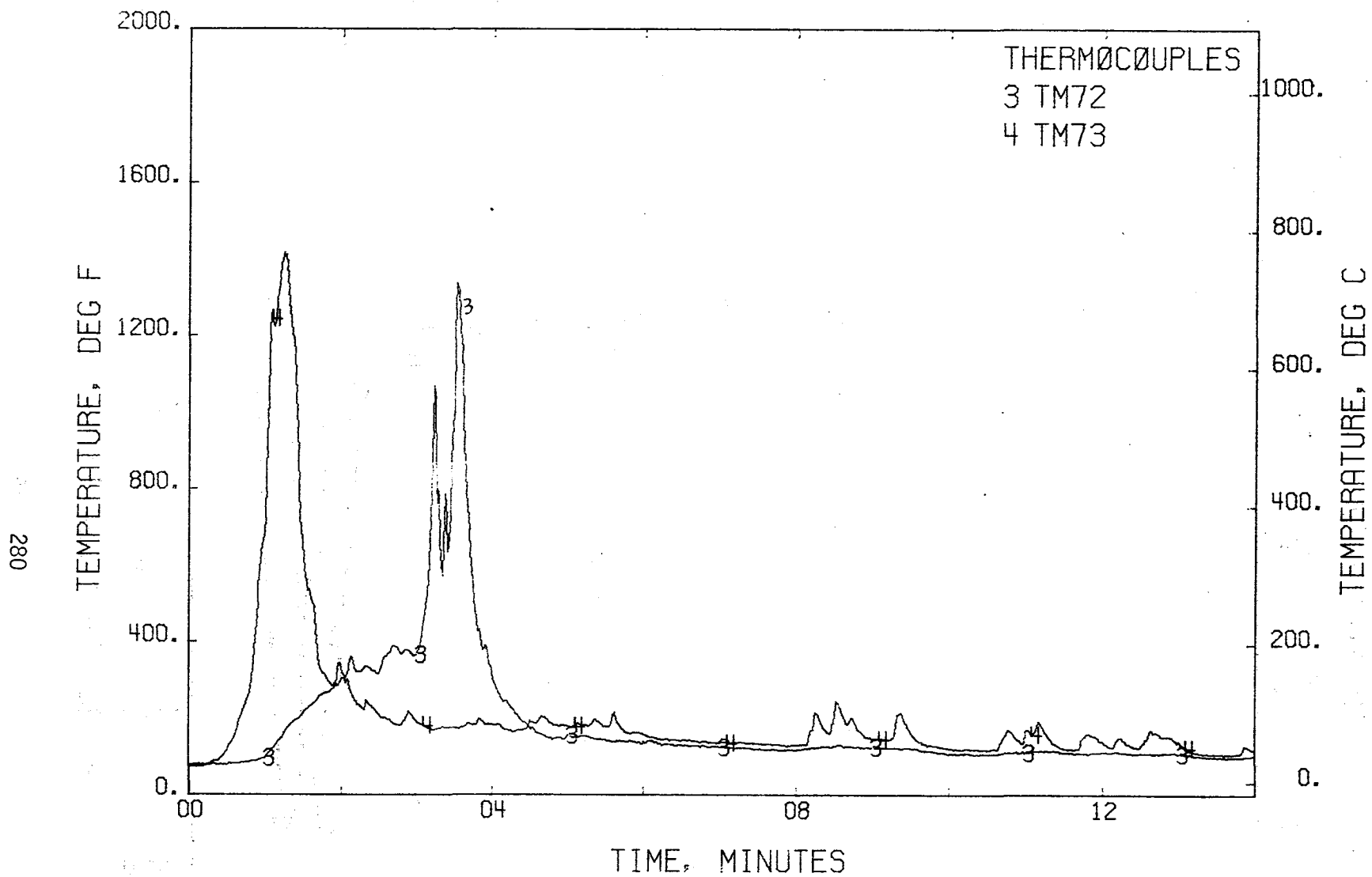


FIGURE 200 . - TEMPERATURES, SEAT BACKS (EDGES)-CONT.  
TEST 13



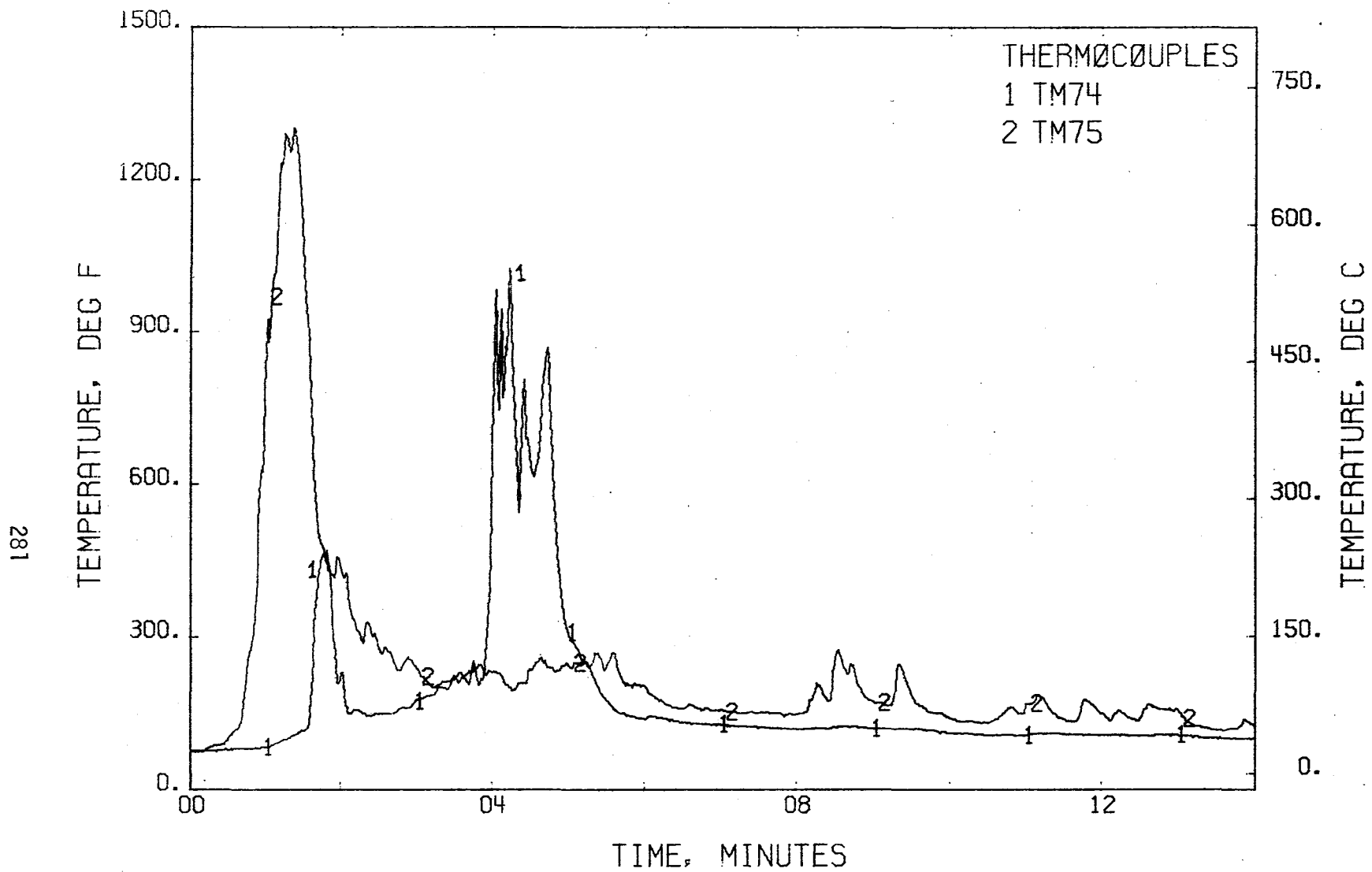


FIGURE 200 . - TEMPERATURES, SEAT BACKS (EDGES)-CONT.  
TEST 13

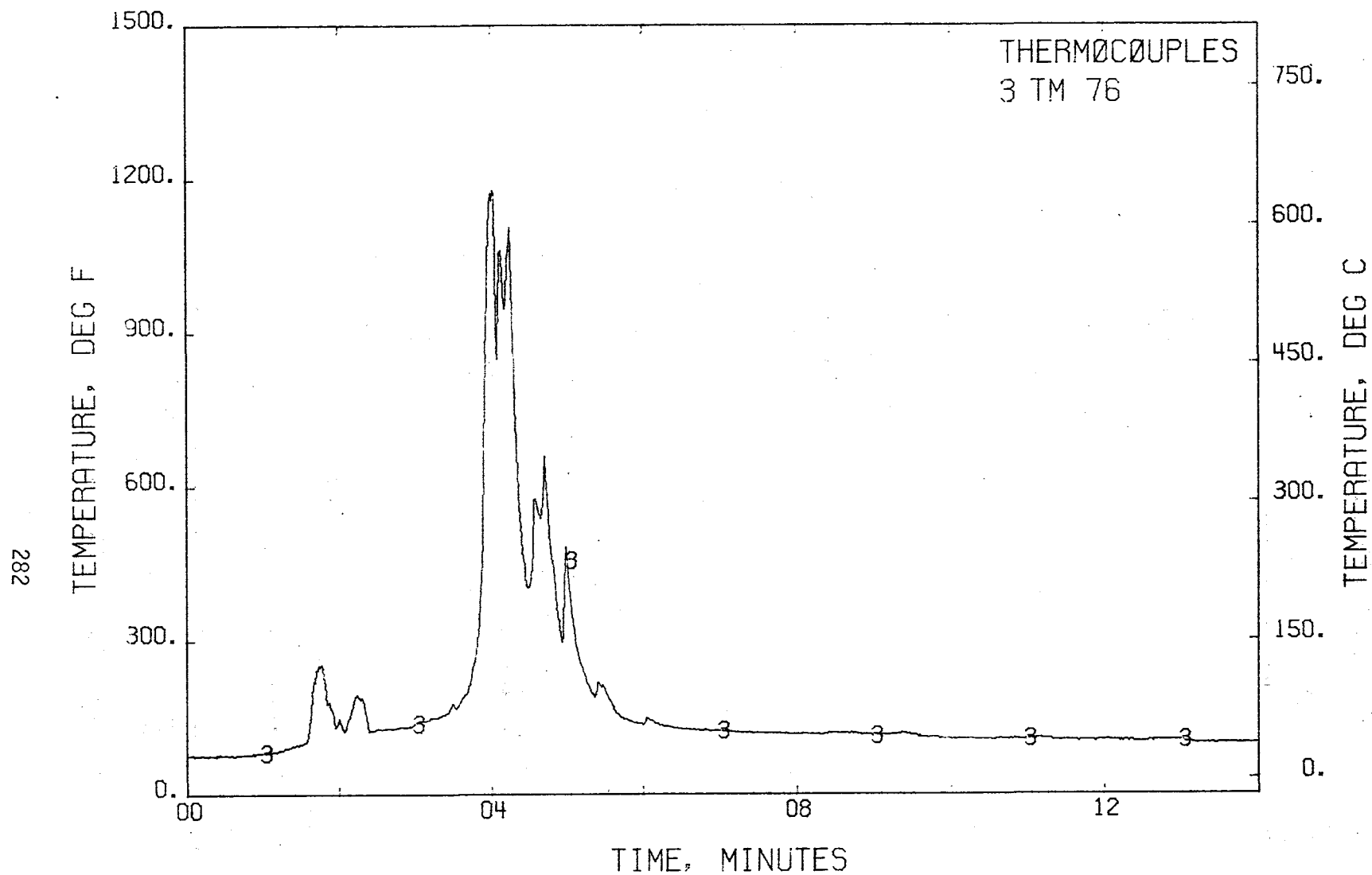


FIGURE 200 . - TEMPERATURES, SEAT BACKS (EDGES)-CONT.  
TEST 13

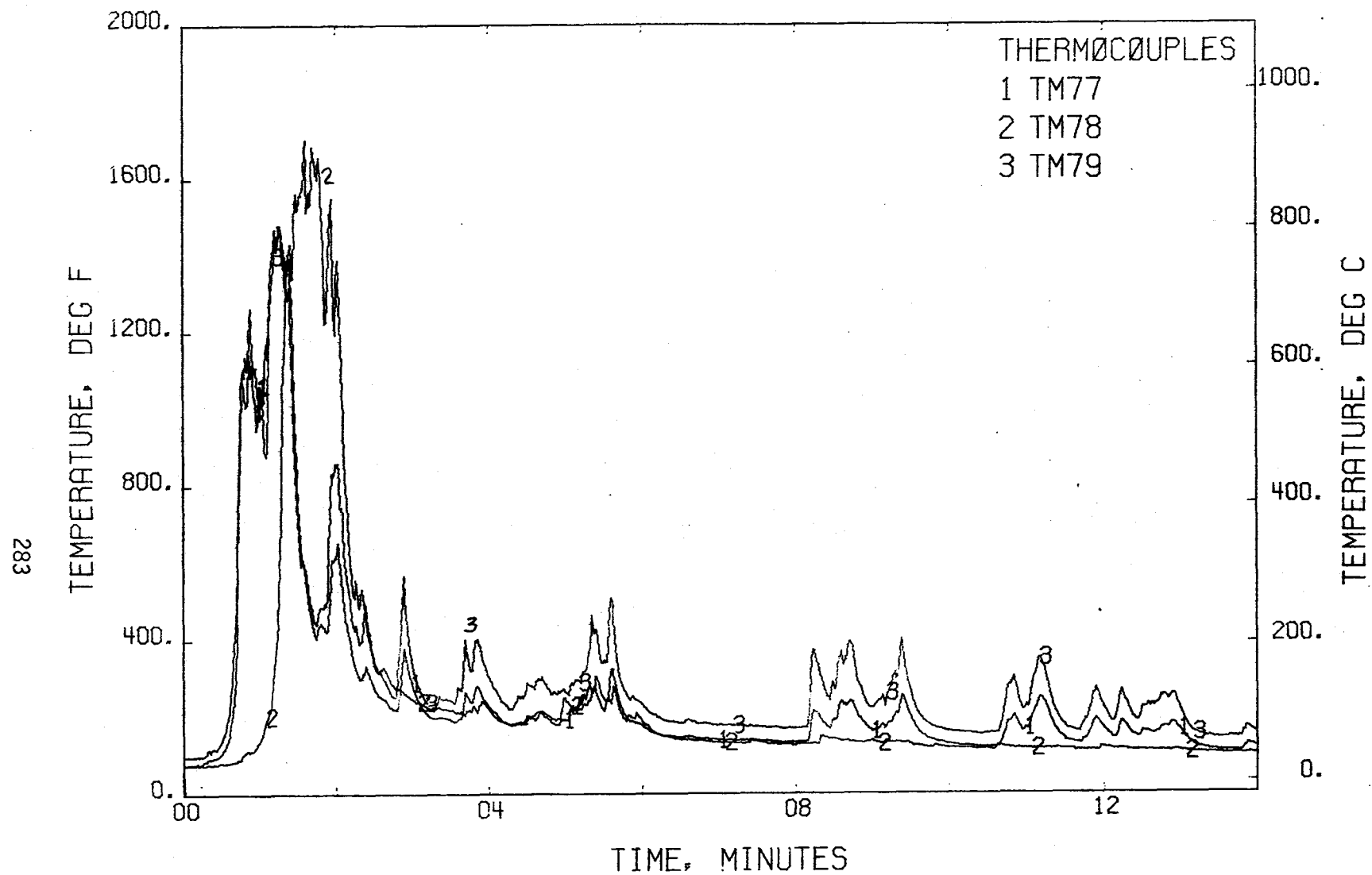


FIGURE 201 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 13

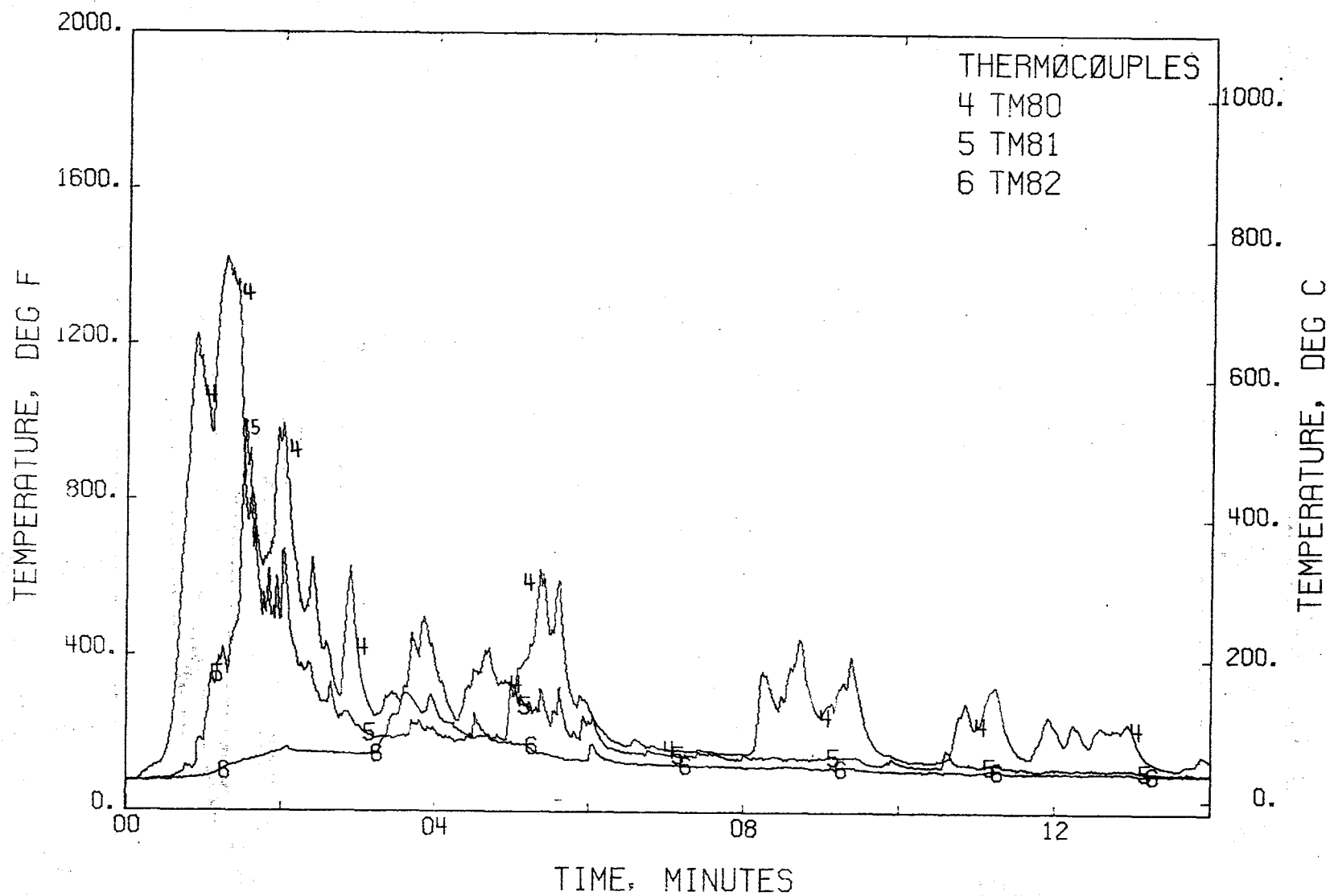


FIGURE 201 . - TEMPERATURES, SEAT BACKS (FRONT) - CONT.  
TEST 13

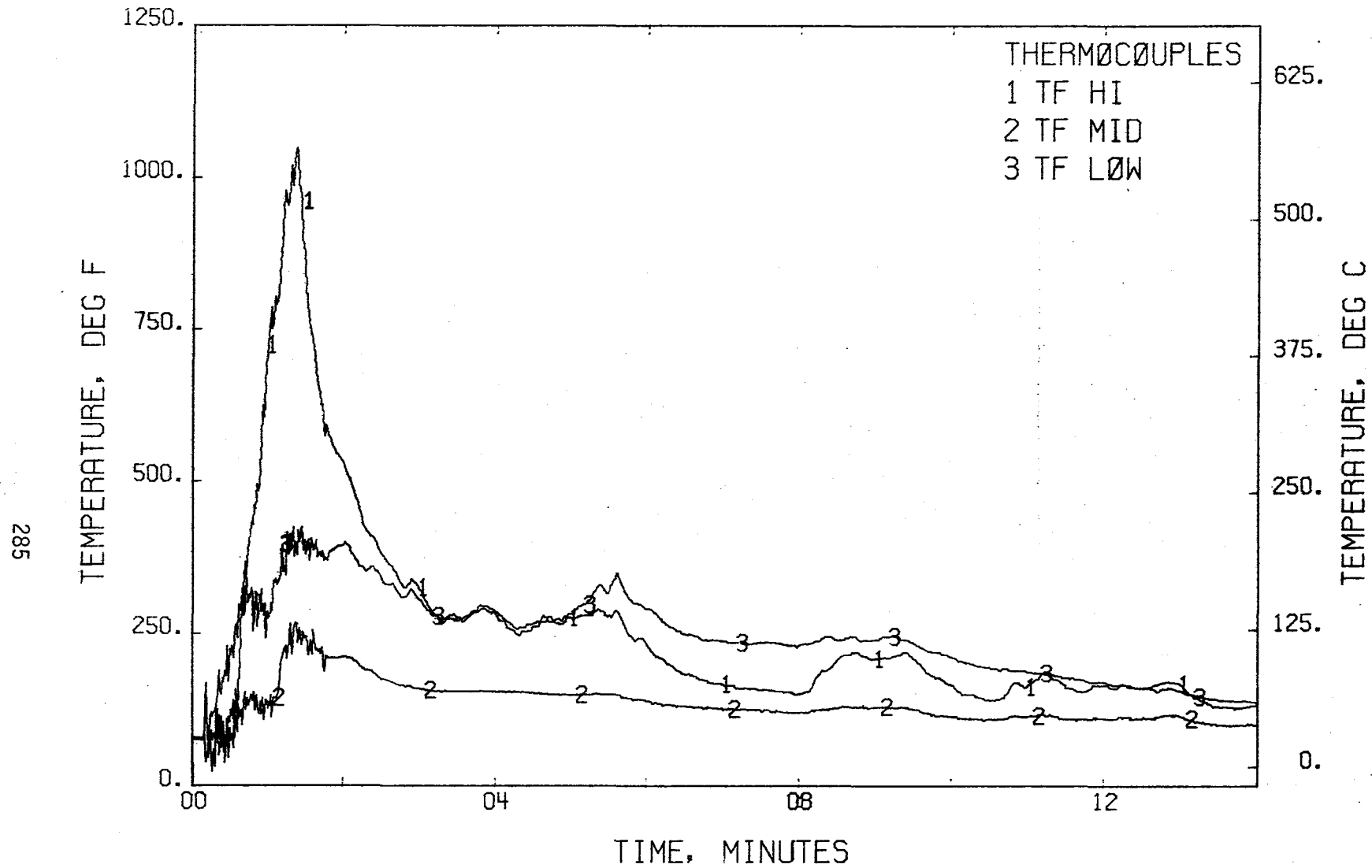


FIGURE 202 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 13

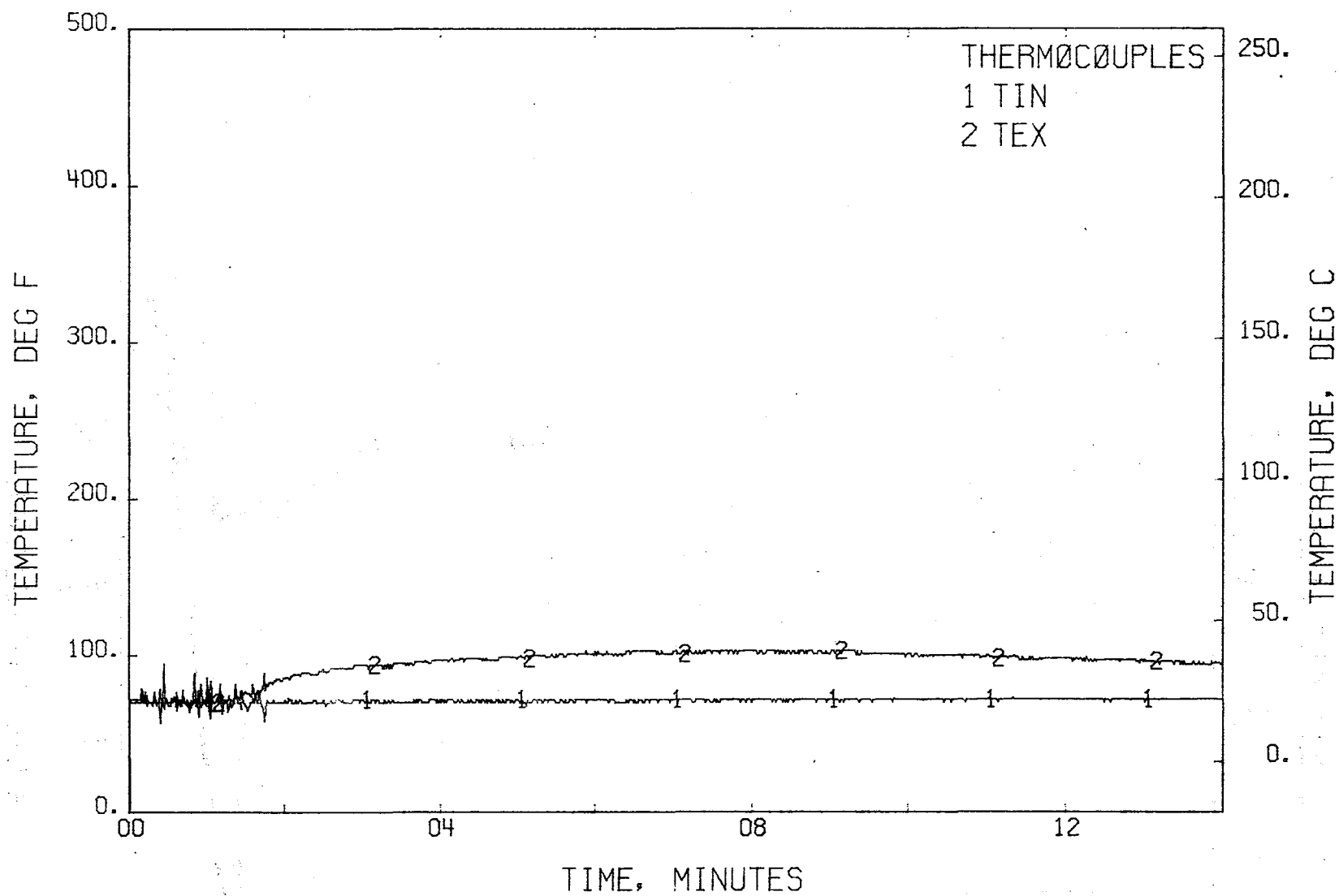


FIGURE 203 . - TEMPERATURES, INLET + EXIT  
TEST 13

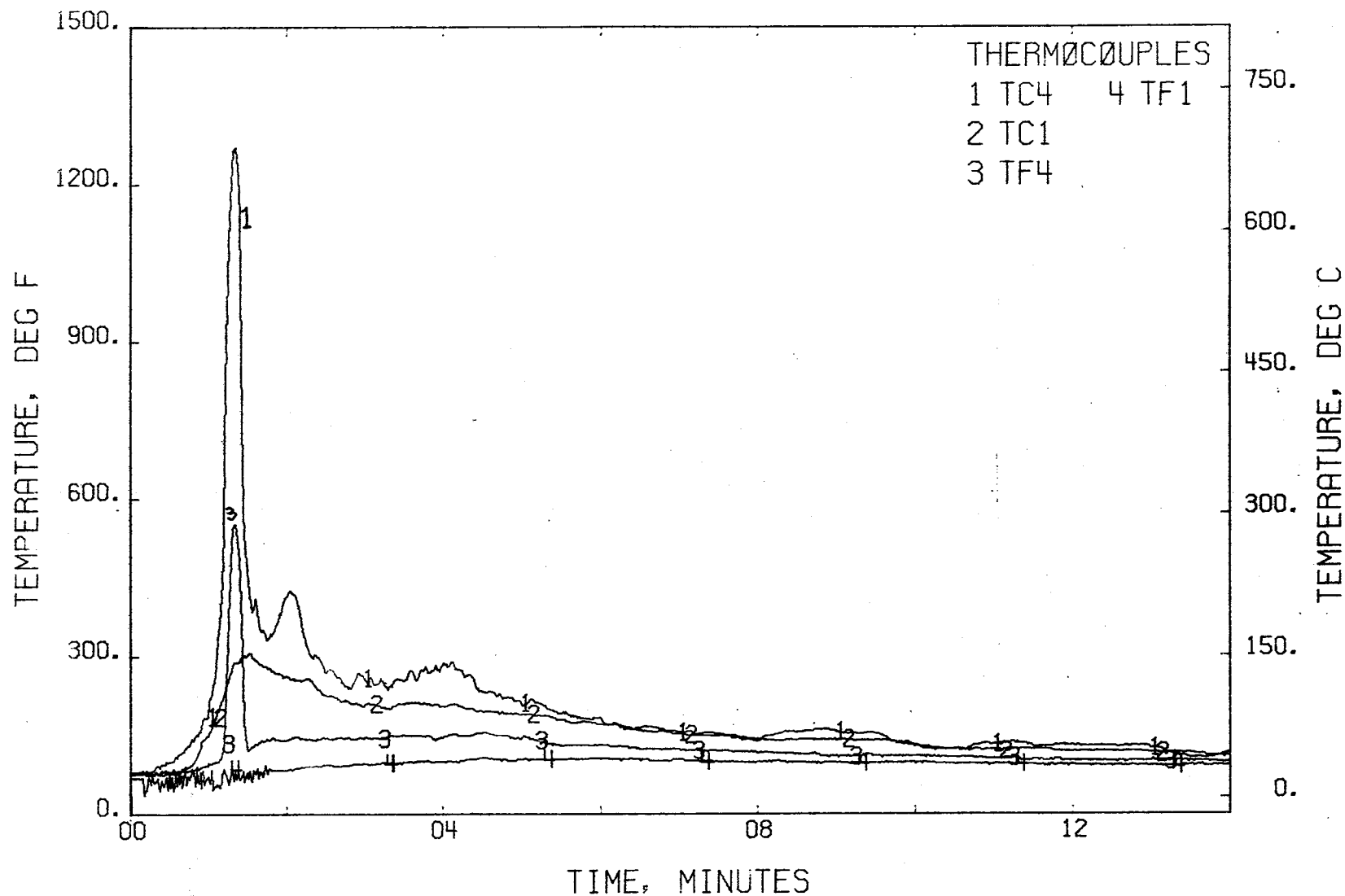


FIGURE 204 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 13

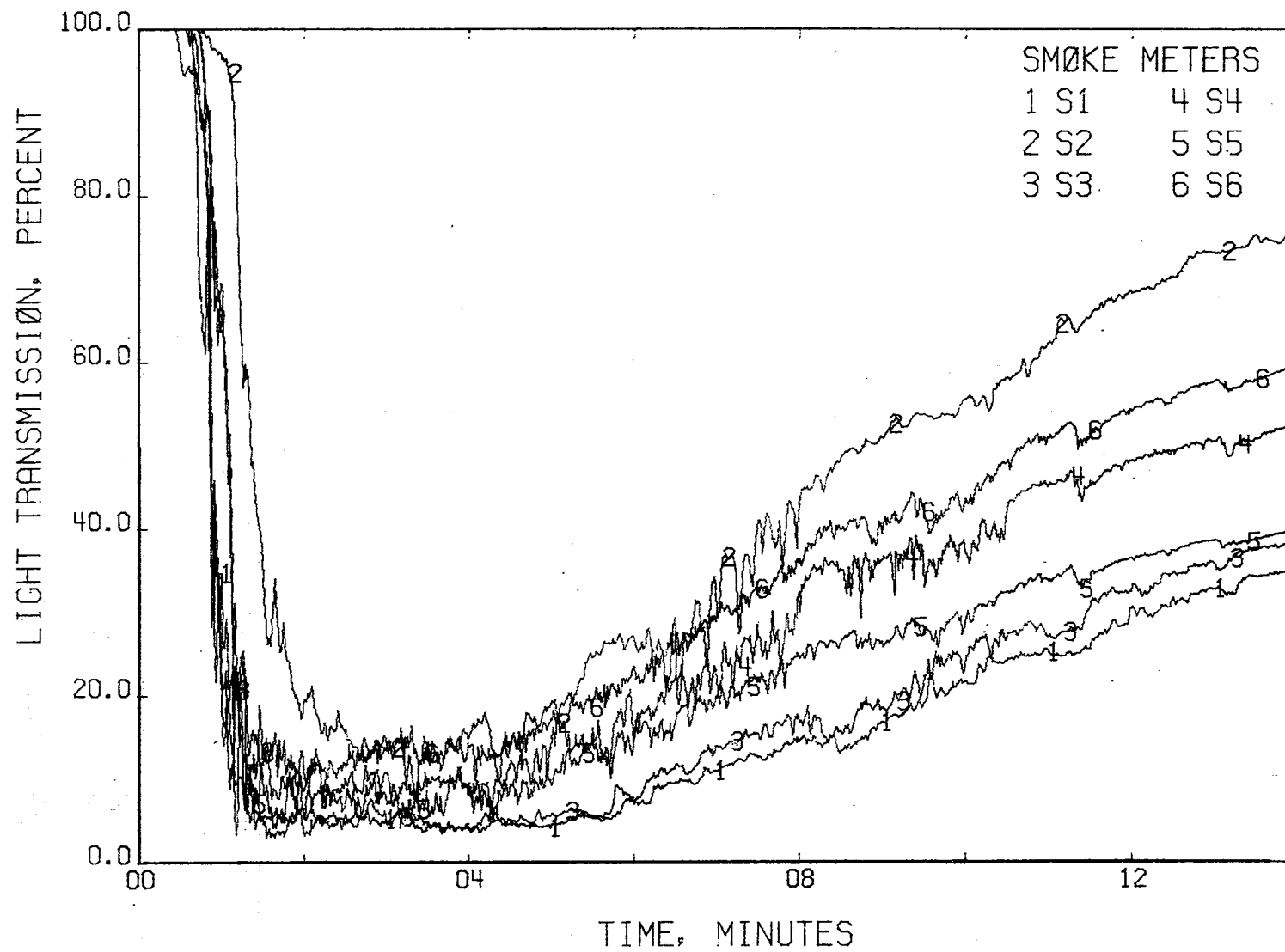


FIGURE 205 . - LIGHT TRANSMISSION  
TEST 13



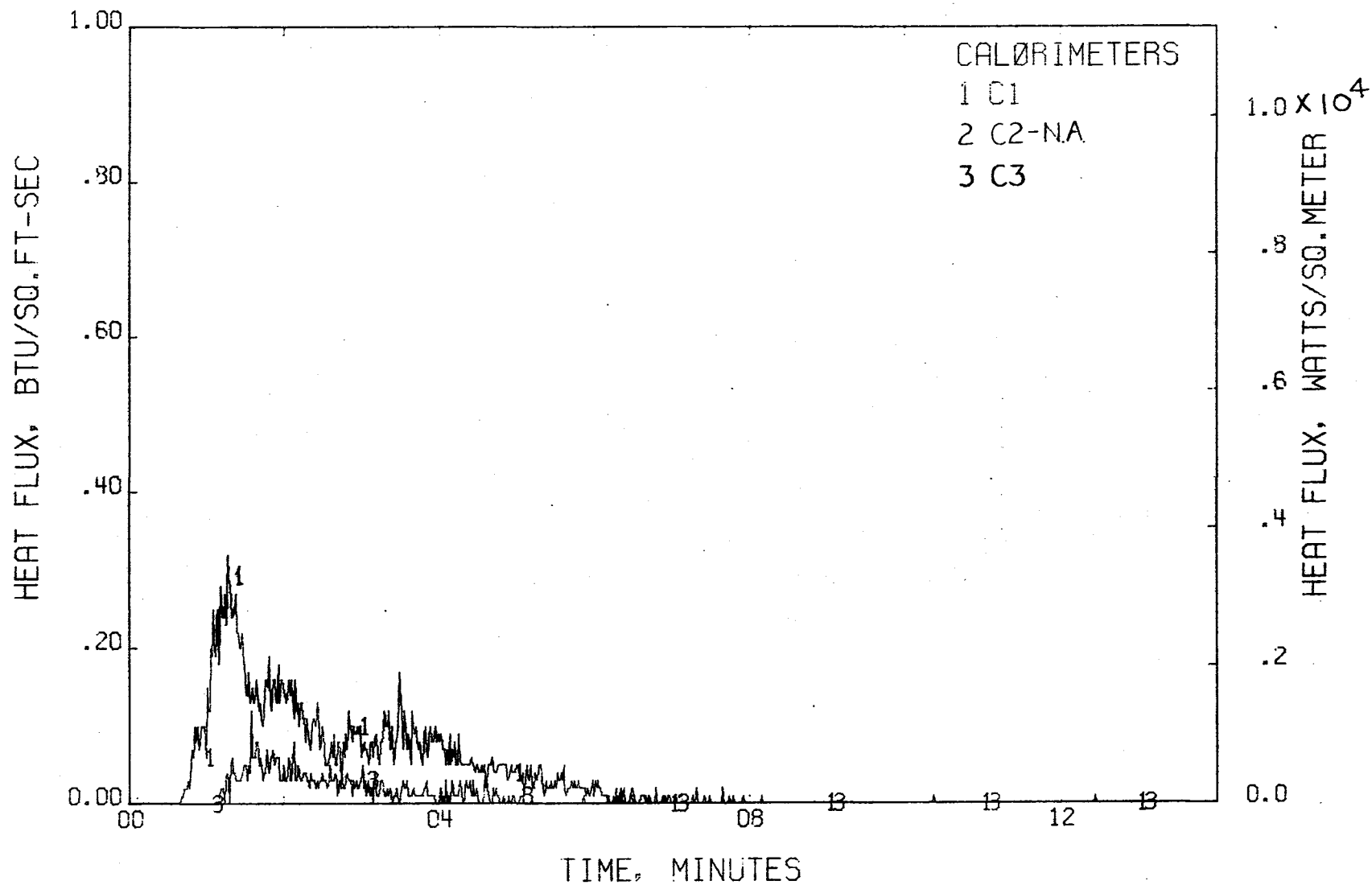


FIGURE 206 . - HEAT FLUX, AFT  
TEST 13

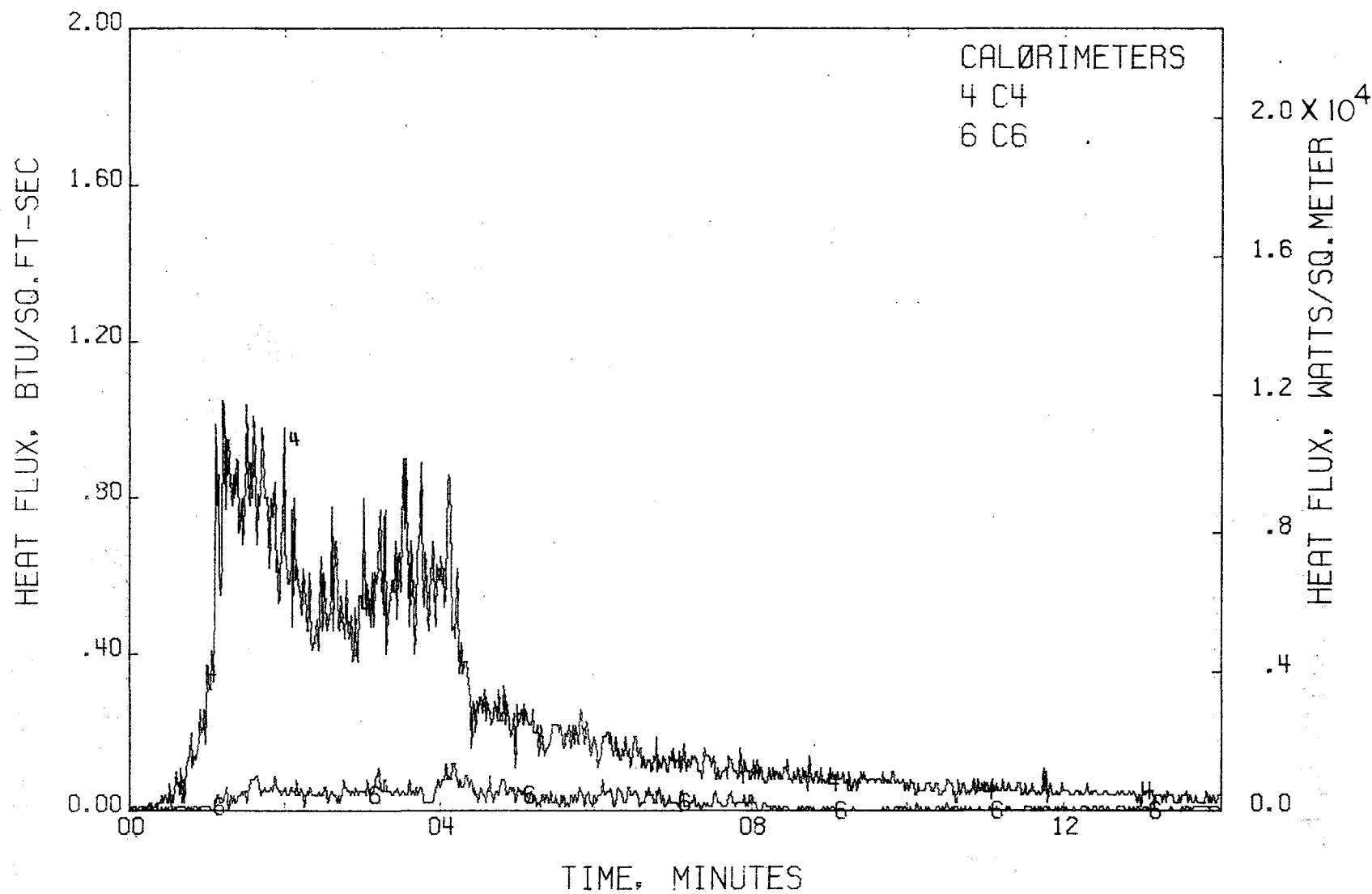


FIGURE 207 . - HEAT FLUX, MIDSECTION  
TEST 13

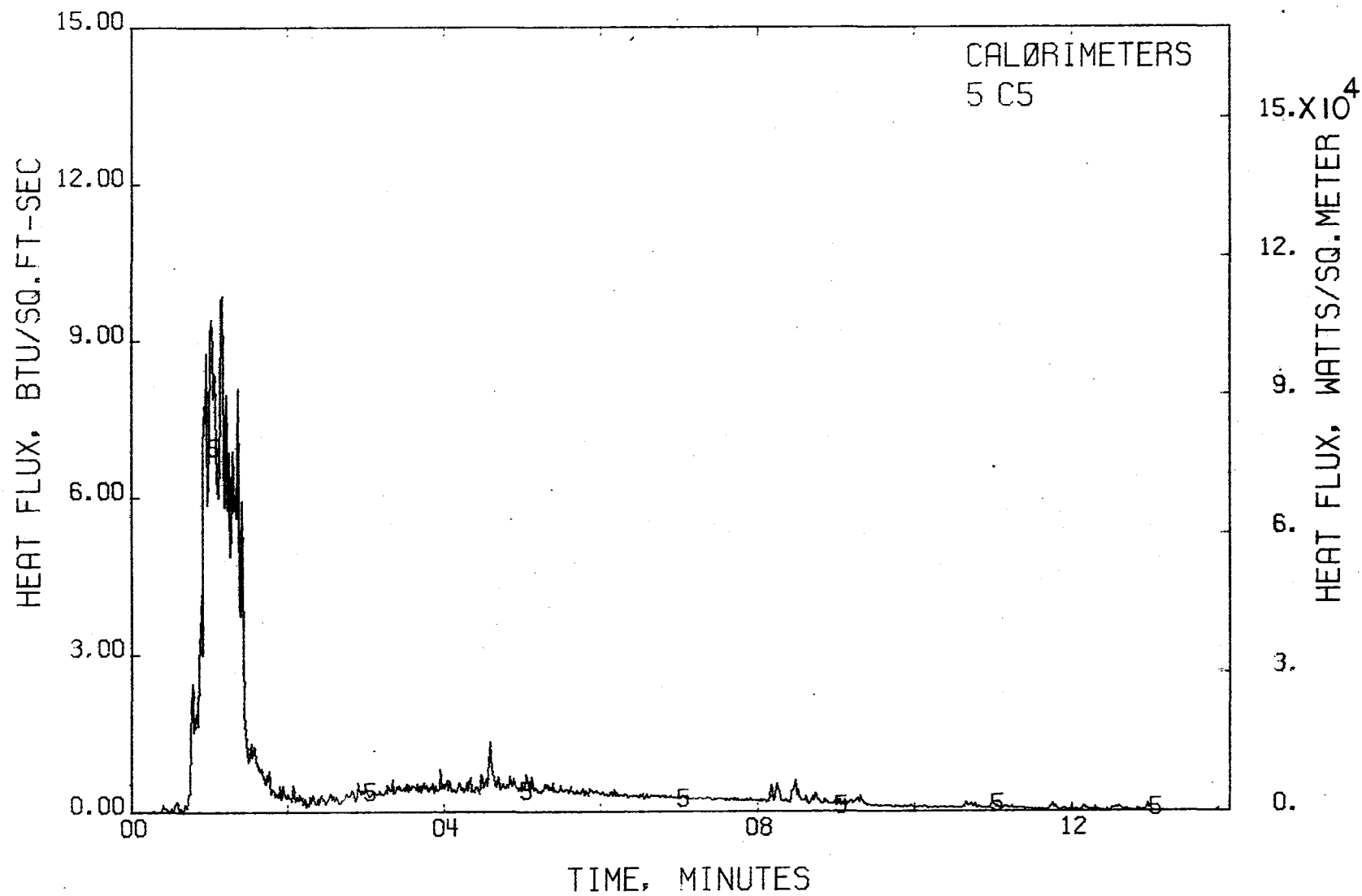


FIGURE 207 . - HEAT FLUX, MIDSECTION - CONTINUED  
TEST 13

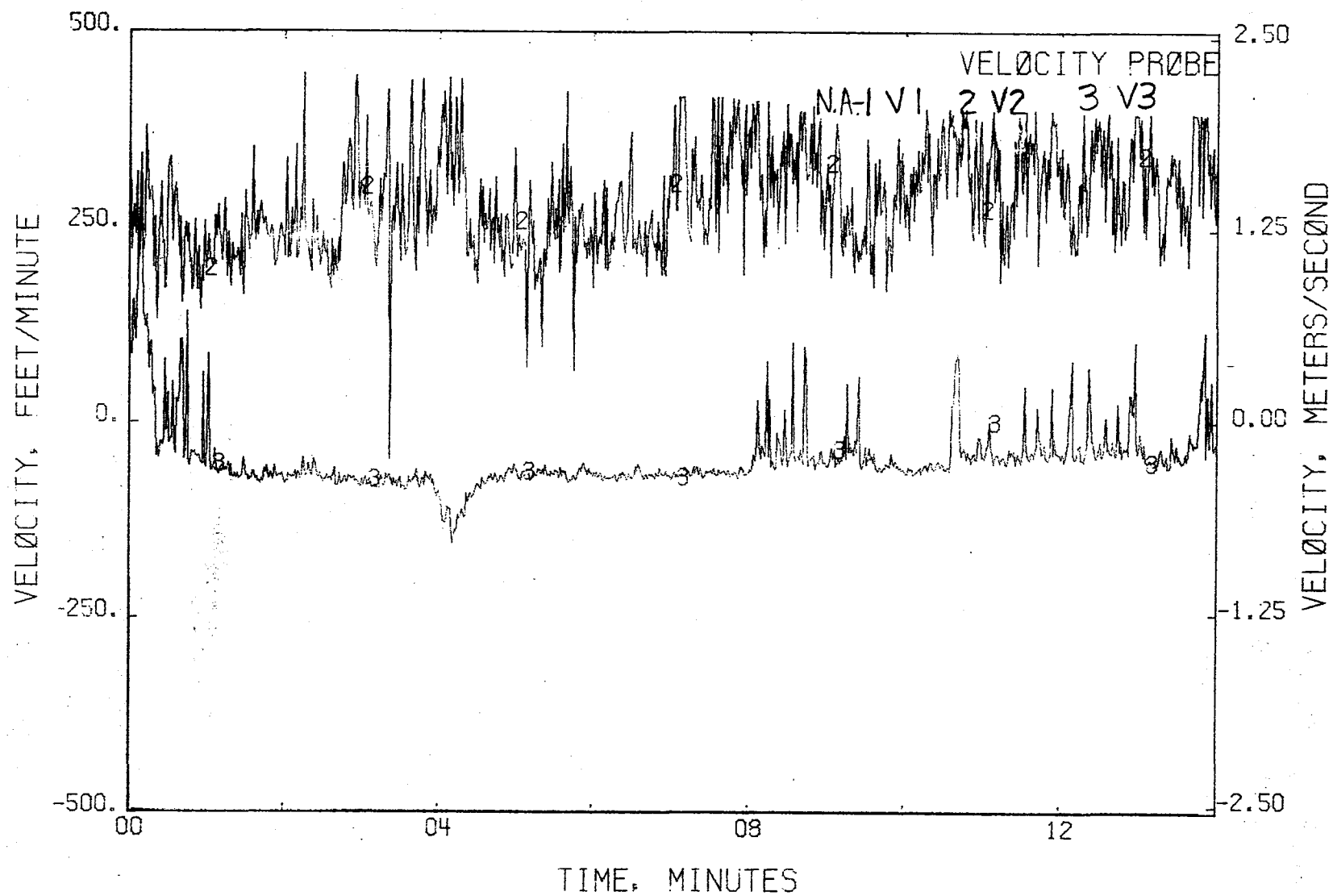


FIGURE 208 . - AIR VELOCITY  
TEST 13

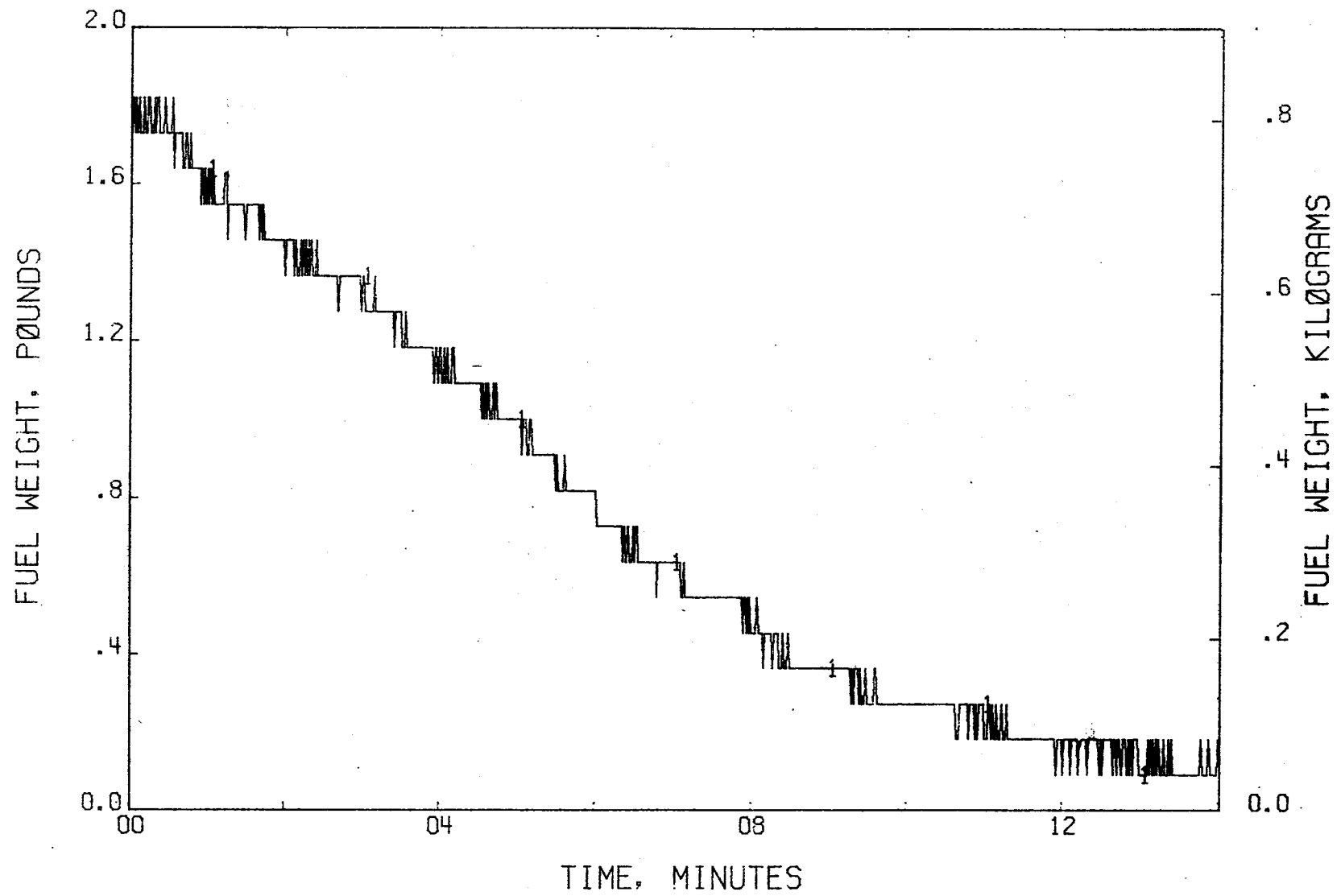


FIGURE 209 . - FUEL WEIGHT LOSS  
TEST 13

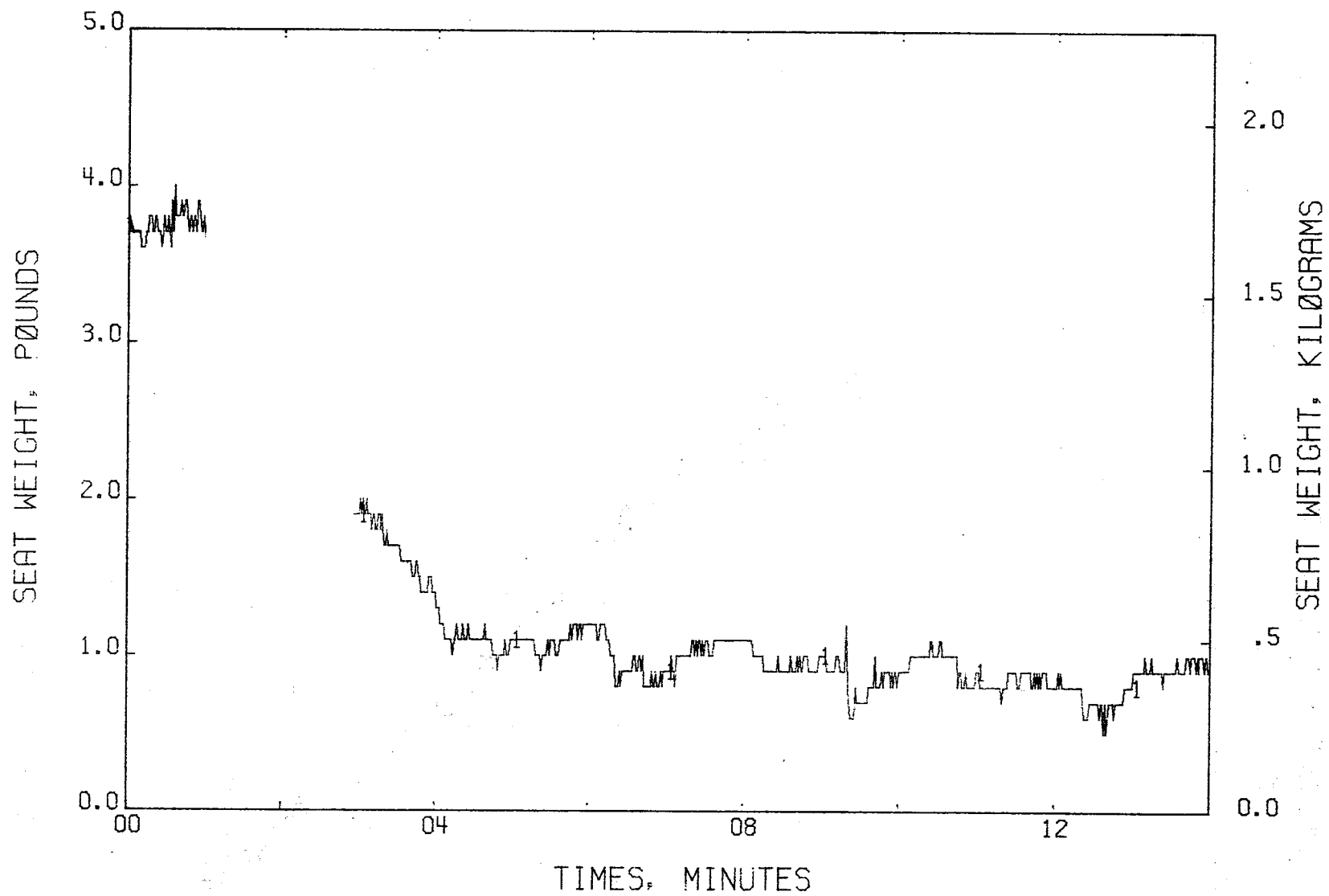


FIGURE 210 . - SEAT WEIGHT LOSS  
TEST 13

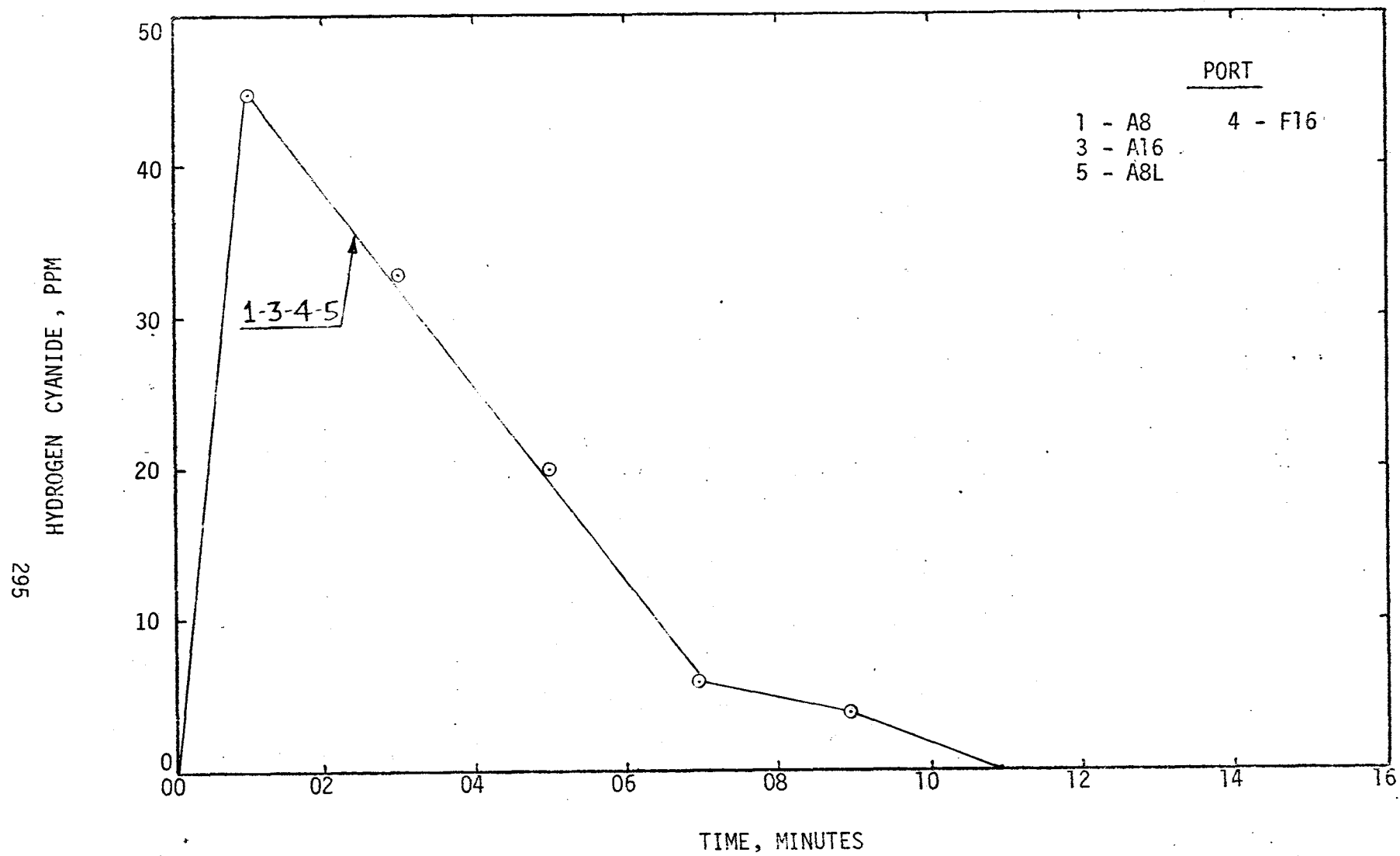


FIGURE 211 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 13

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 3 PPM



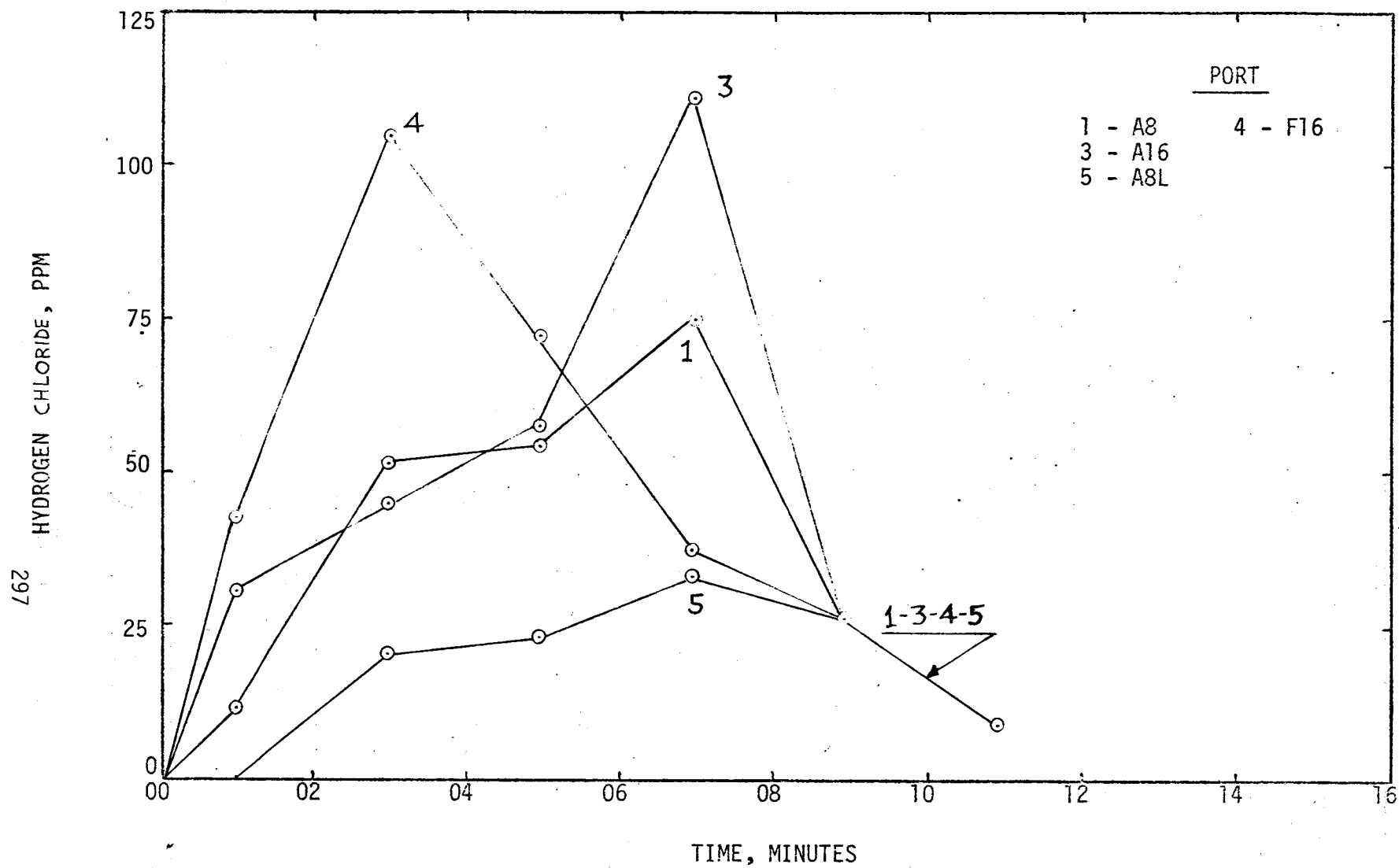


FIGURE 213 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 13

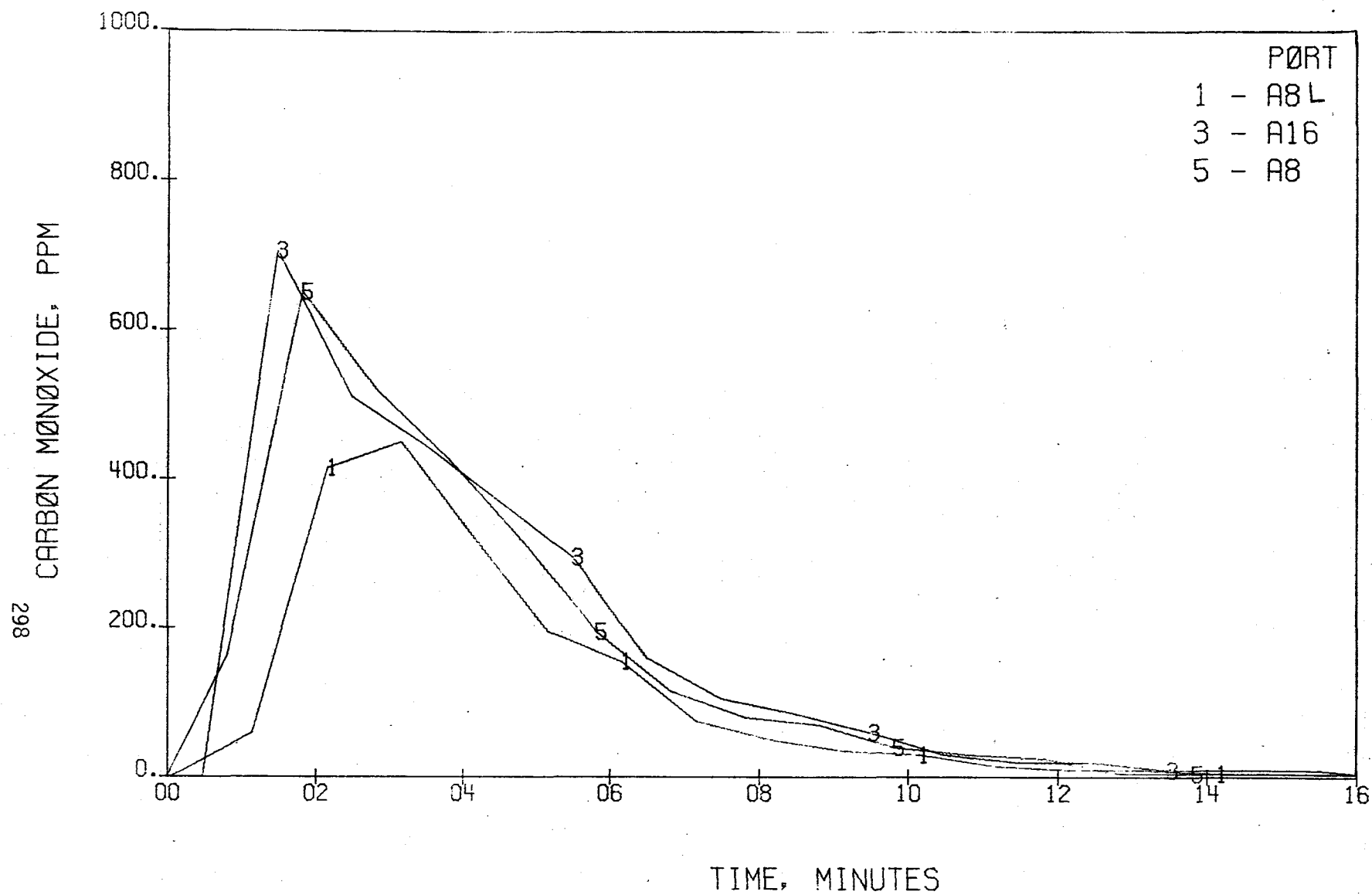


FIGURE 214 - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 13

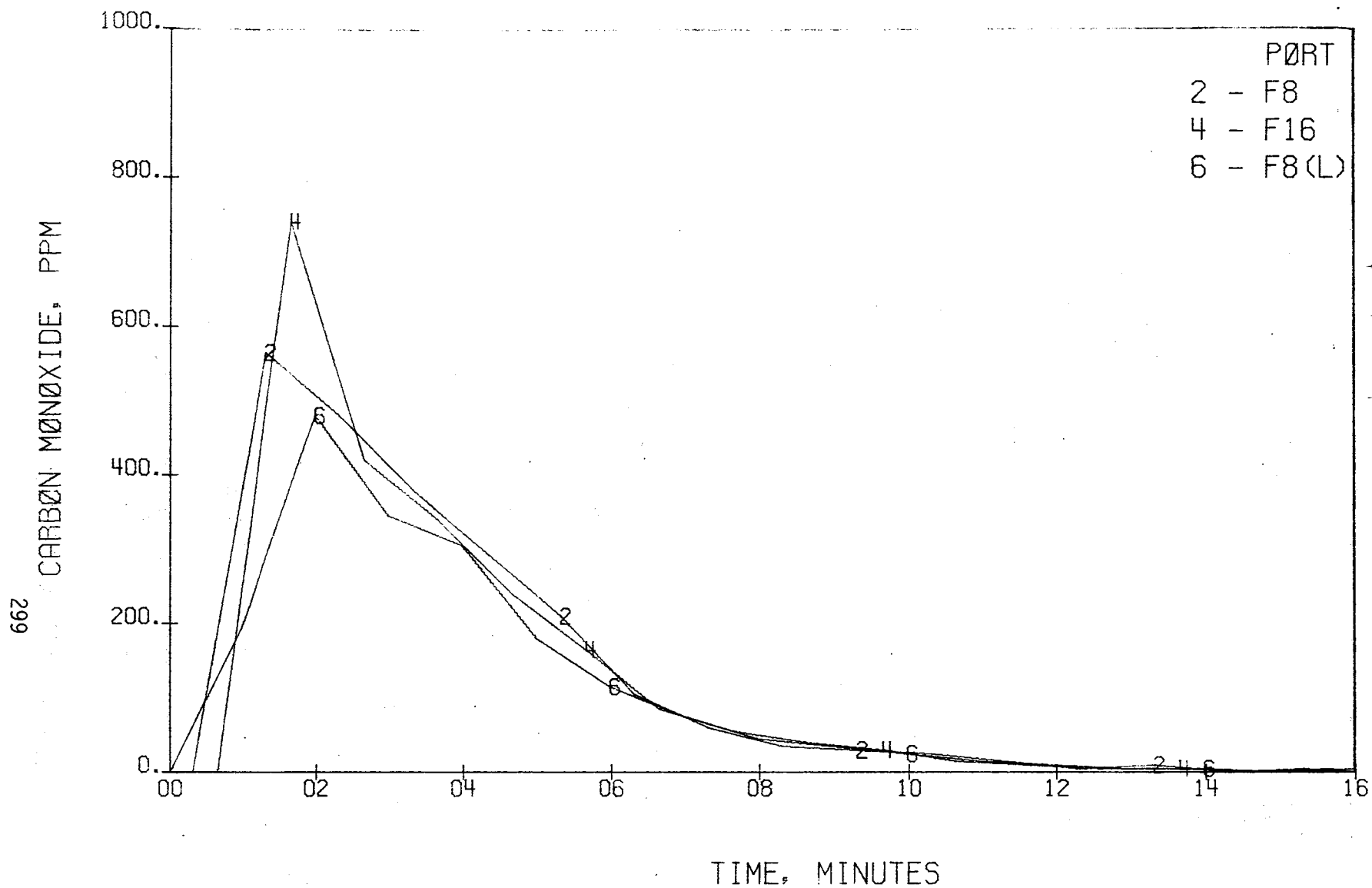


FIGURE 215 - CARBON MONOXIDE CONCENTRATIONS, FØRE  
TEST 13

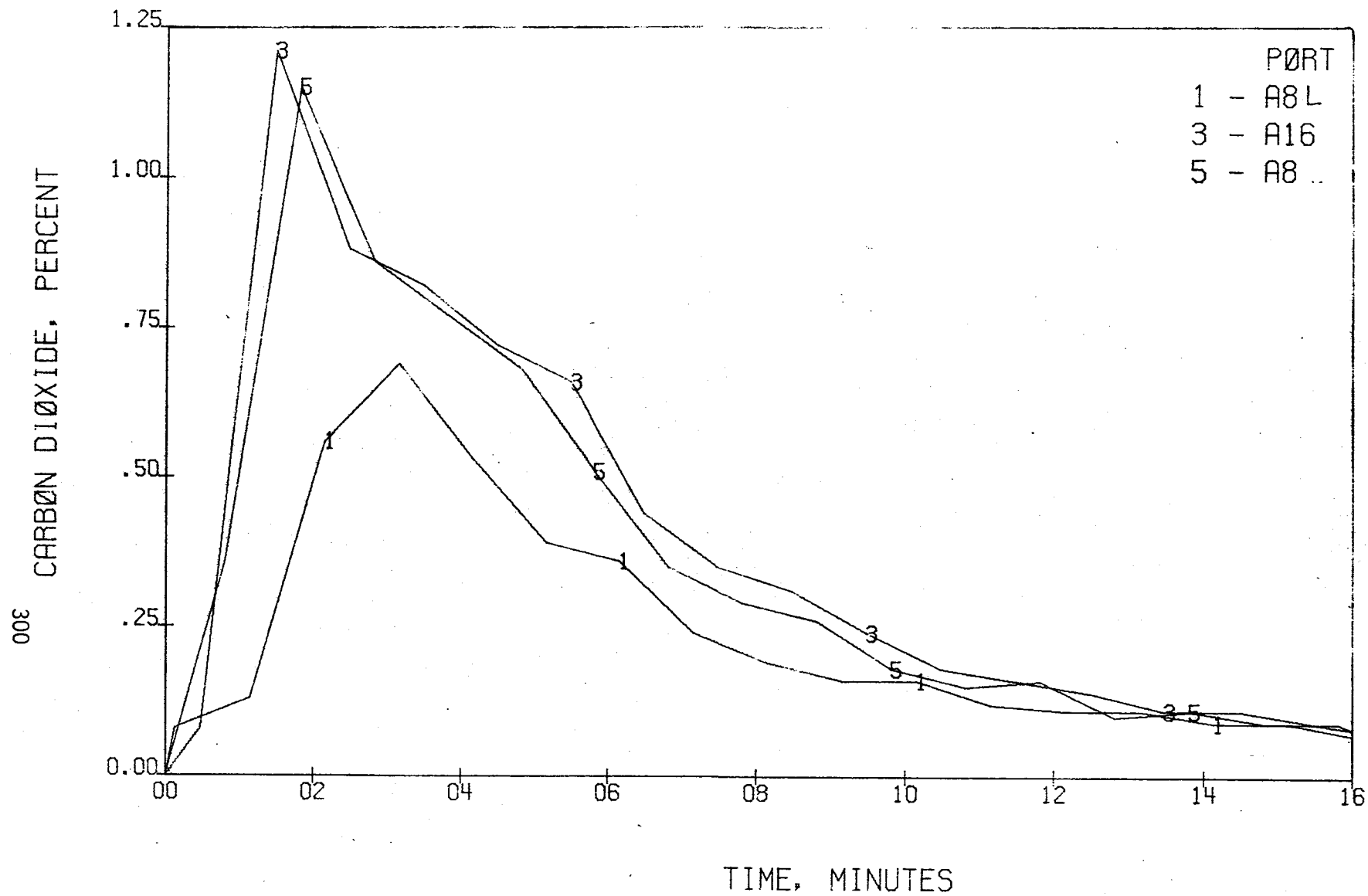


FIGURE 216 - CARBON DIOXIDE CONCENTRATIONS, AFT TEST 13

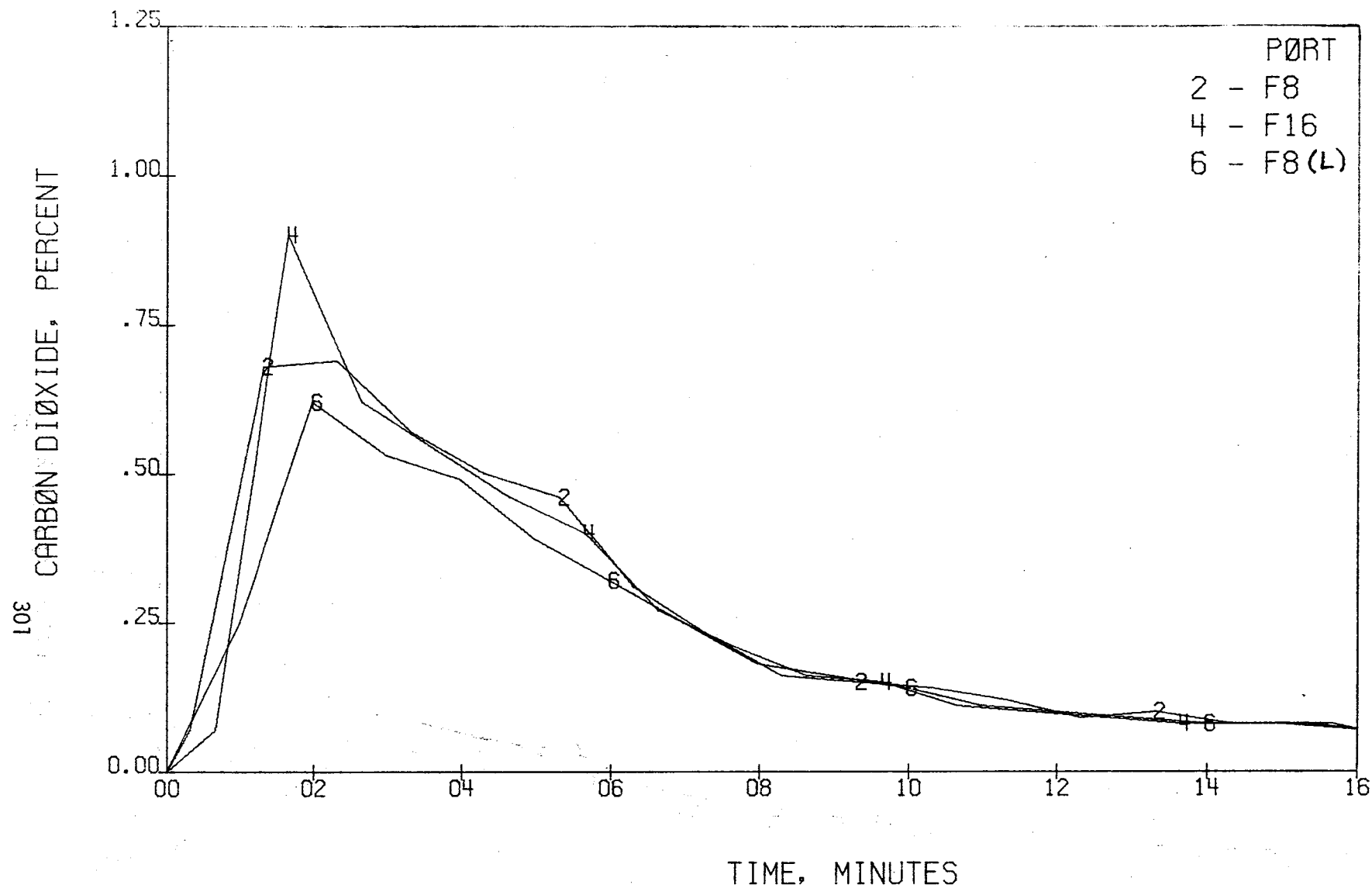


FIGURE 217 .- CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 13

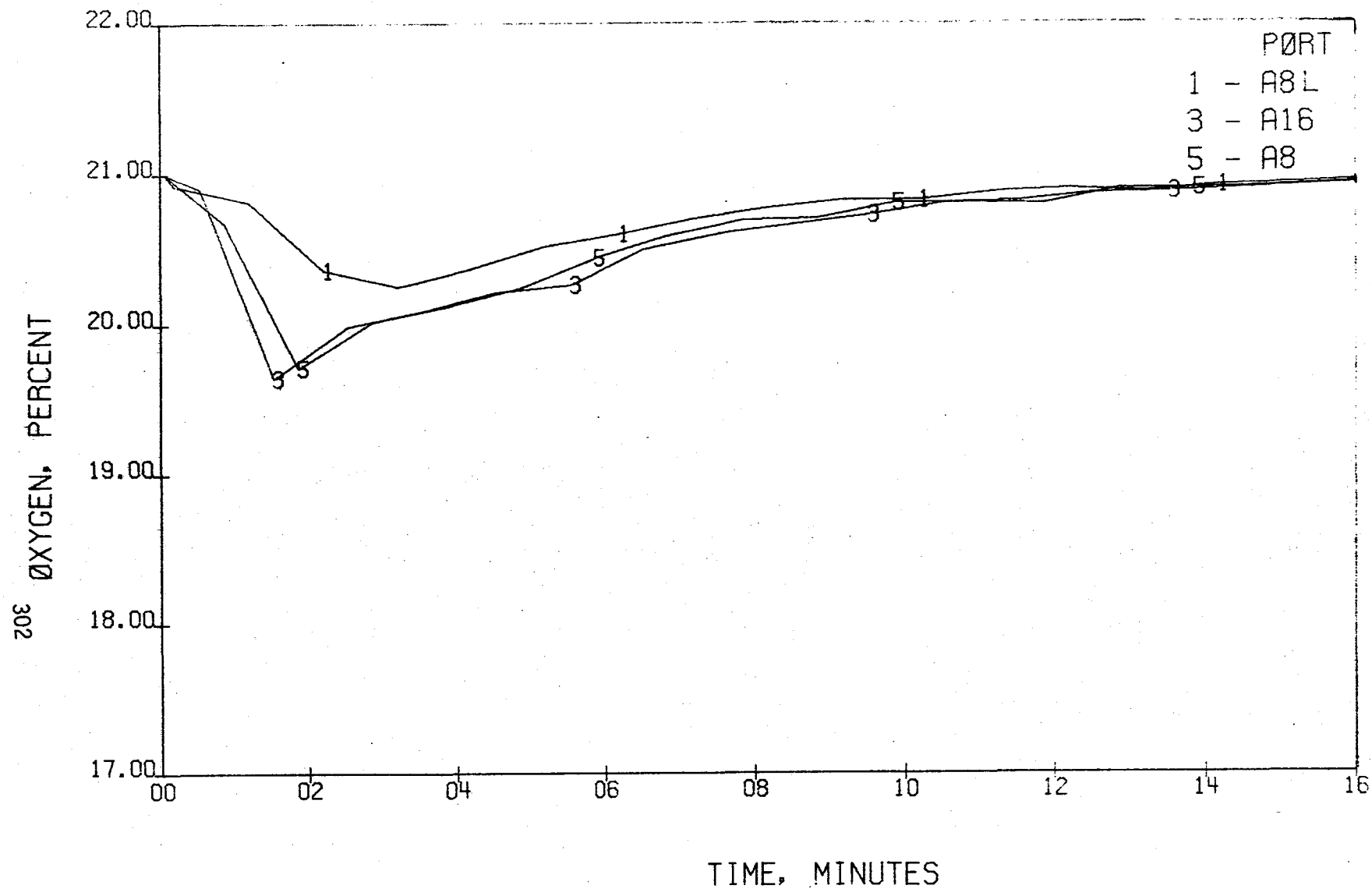


FIGURE 218 . - OXYGEN CONCENTRATIONS , AFT  
TEST 13

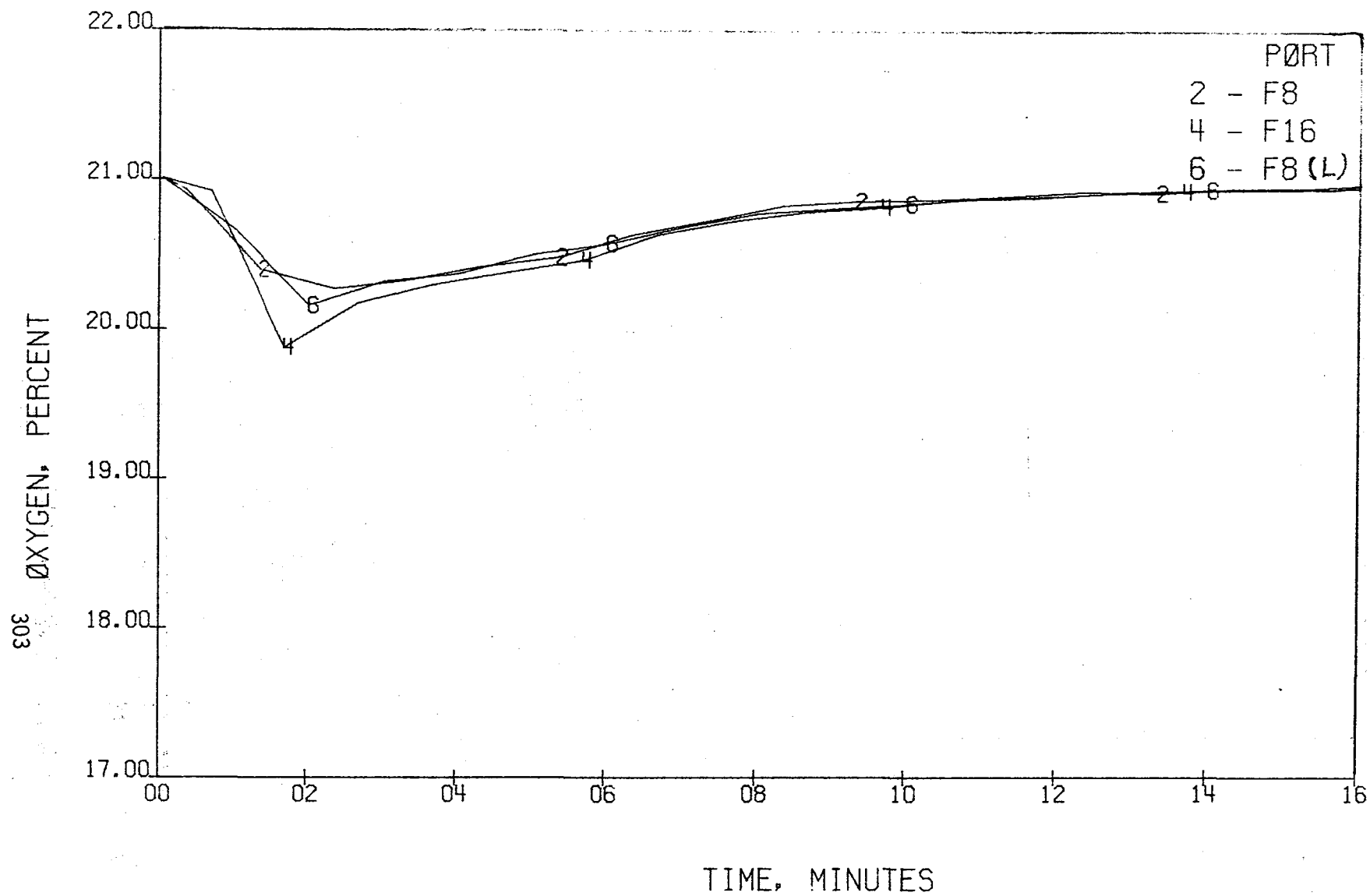


FIGURE 219 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 13

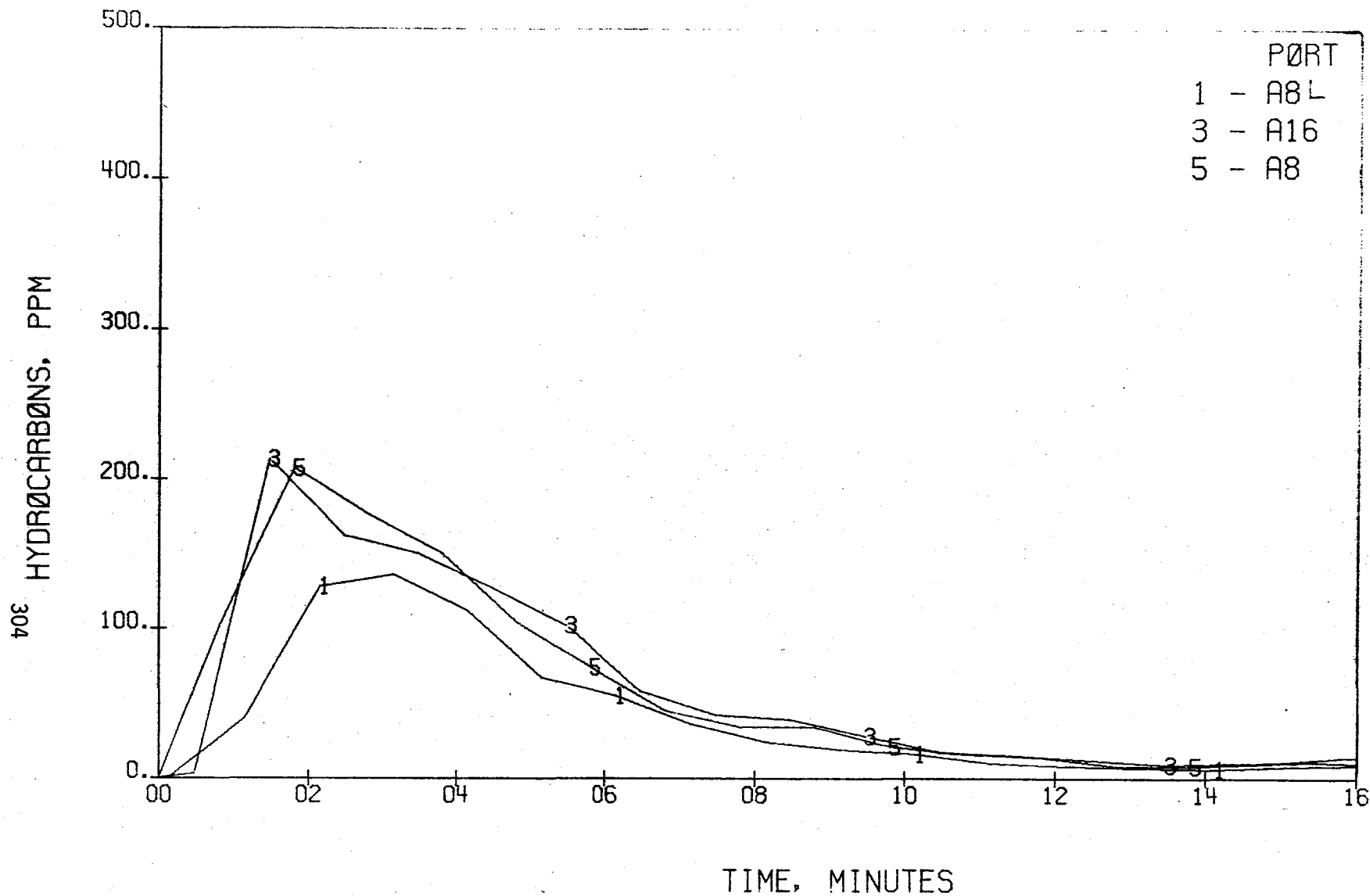


FIGURE 220 .- HYDROCARBONS CONCENTRATIONS, AFT  
TEST 13



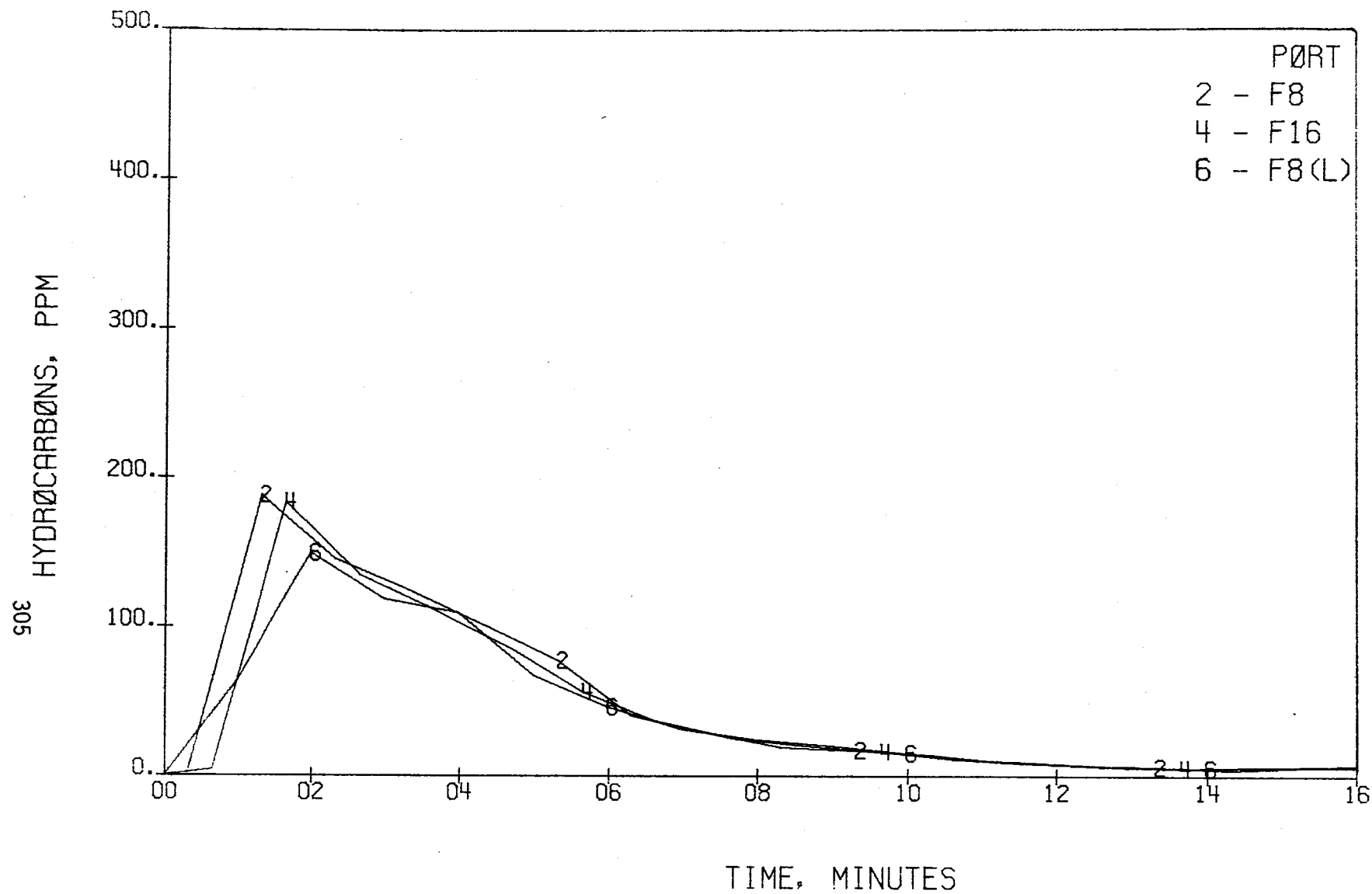


FIGURE 221 . - HYDROCARBONS CONCENTRATIONS , FØRE  
TEST 13



TEST 14

---

BARE URETHANE FOAM SEATS (CUSHIONS ONLY)

TEST 14

BARE URETHANE FOAM SEATS (CUSHIONS ONLY)



FIGURE 222. - PRE-TEST CONFIGURATION, TEST 14



FIGURE 223 . - POST-TEST CONFIGURATION, TEST 14





FIGURE 224 . - FIRE DURING TEST 14

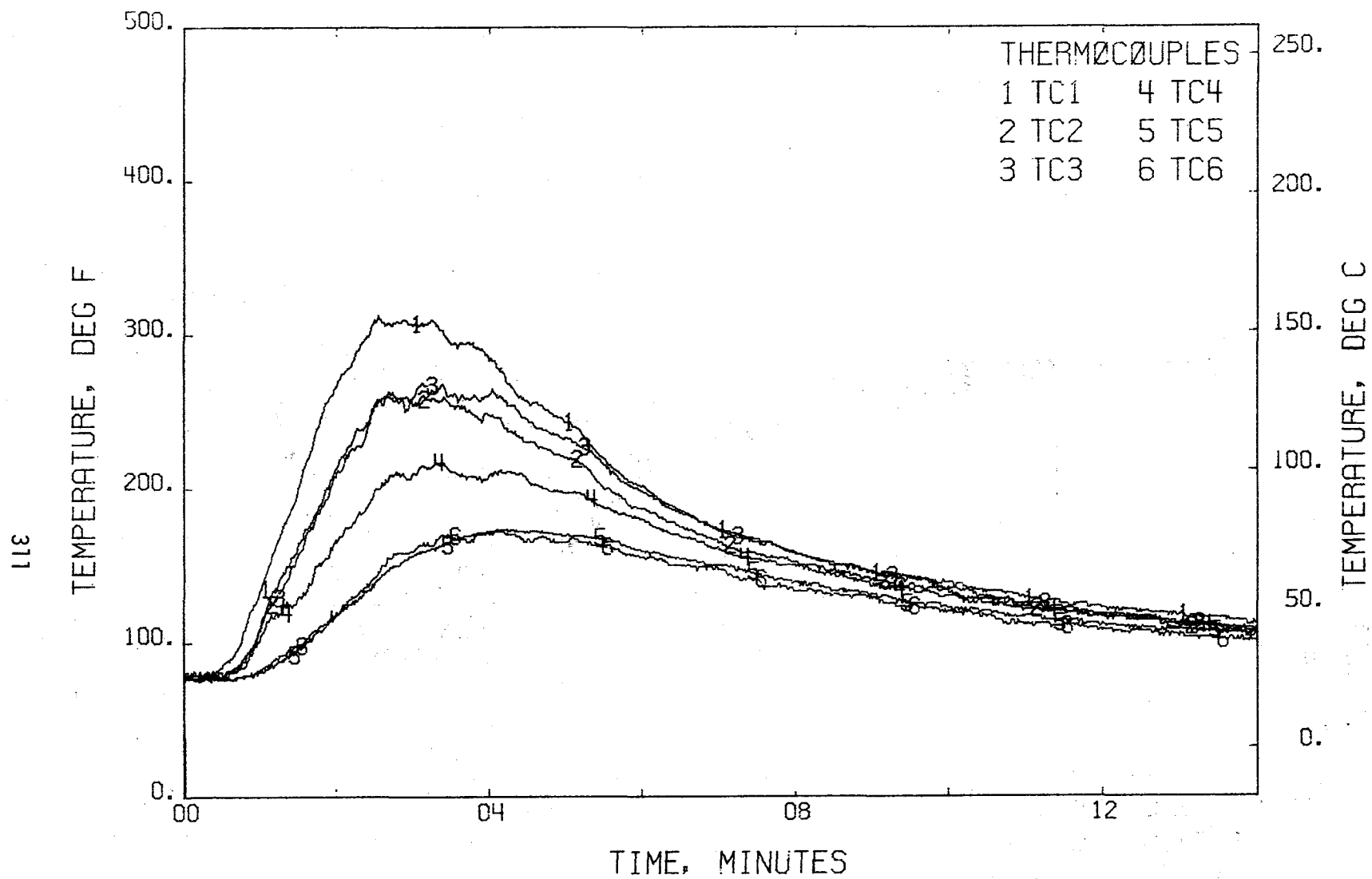


FIGURE 225 . - TEMPERATURES, T/C TREE 1  
TEST 14

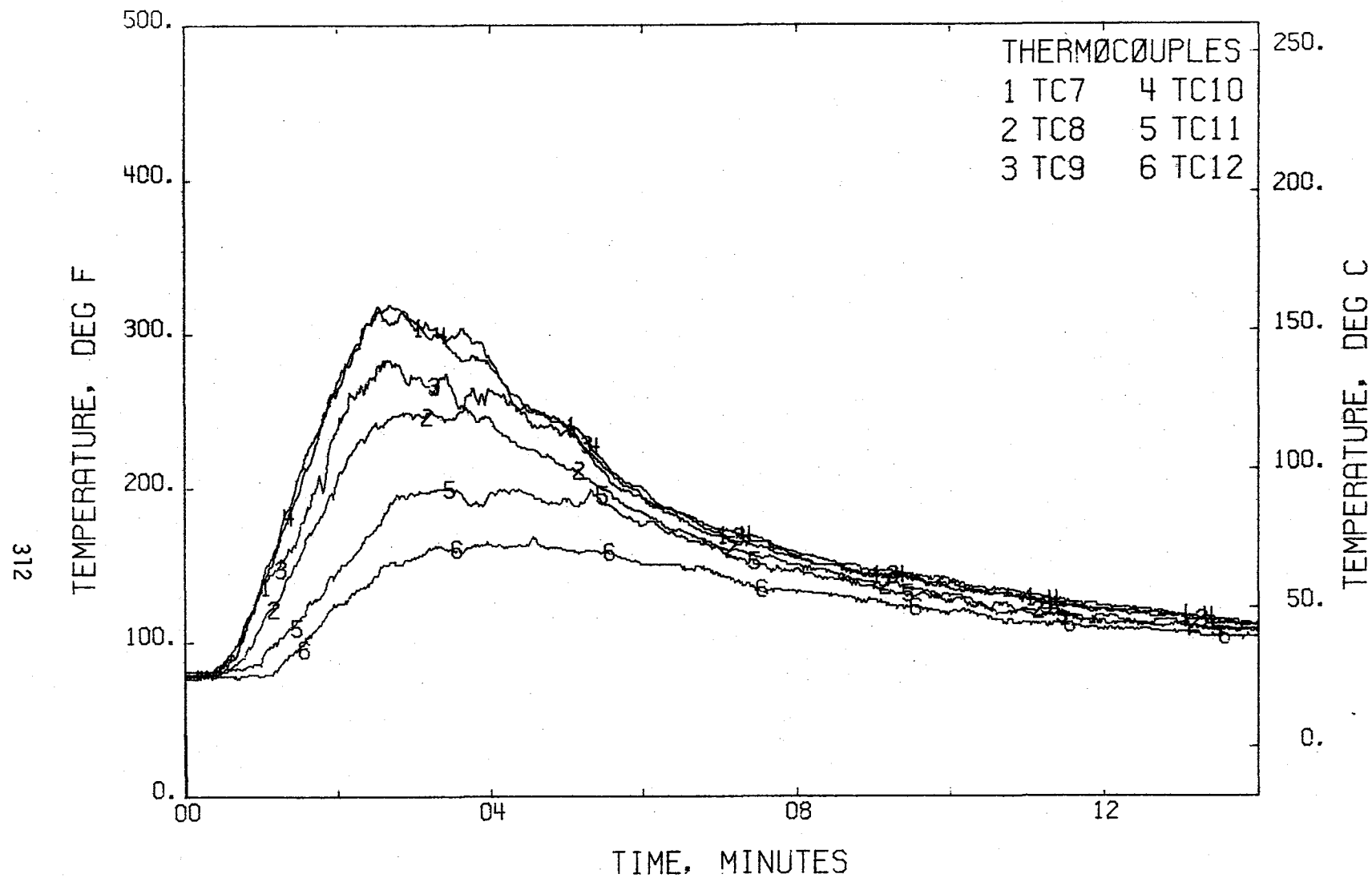


FIGURE 226 . - TEMPERATURES, T/C TREE 2  
TEST 14



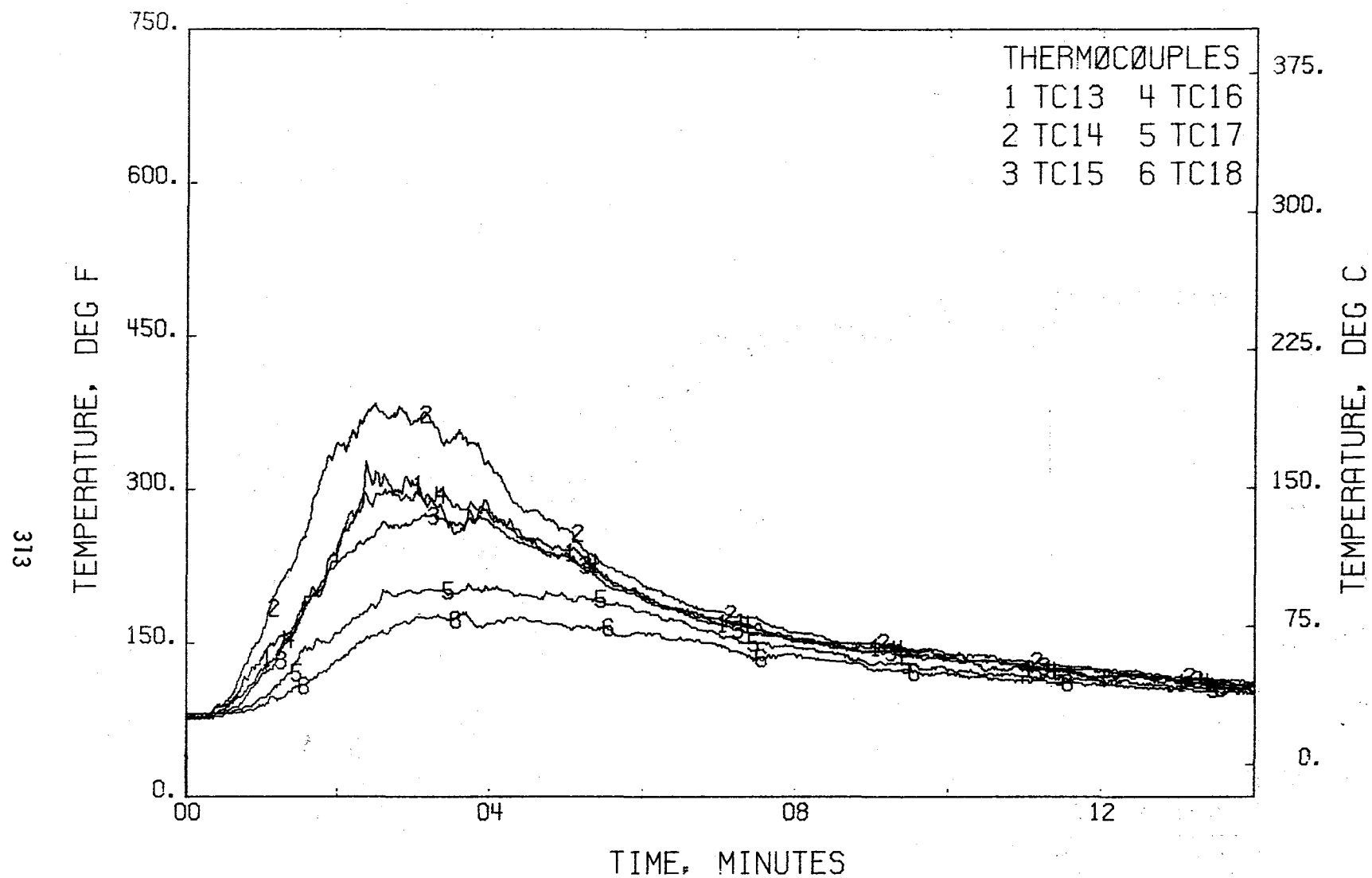


FIGURE 227 . - TEMPERATURES, T/C TREE 3  
TEST 14

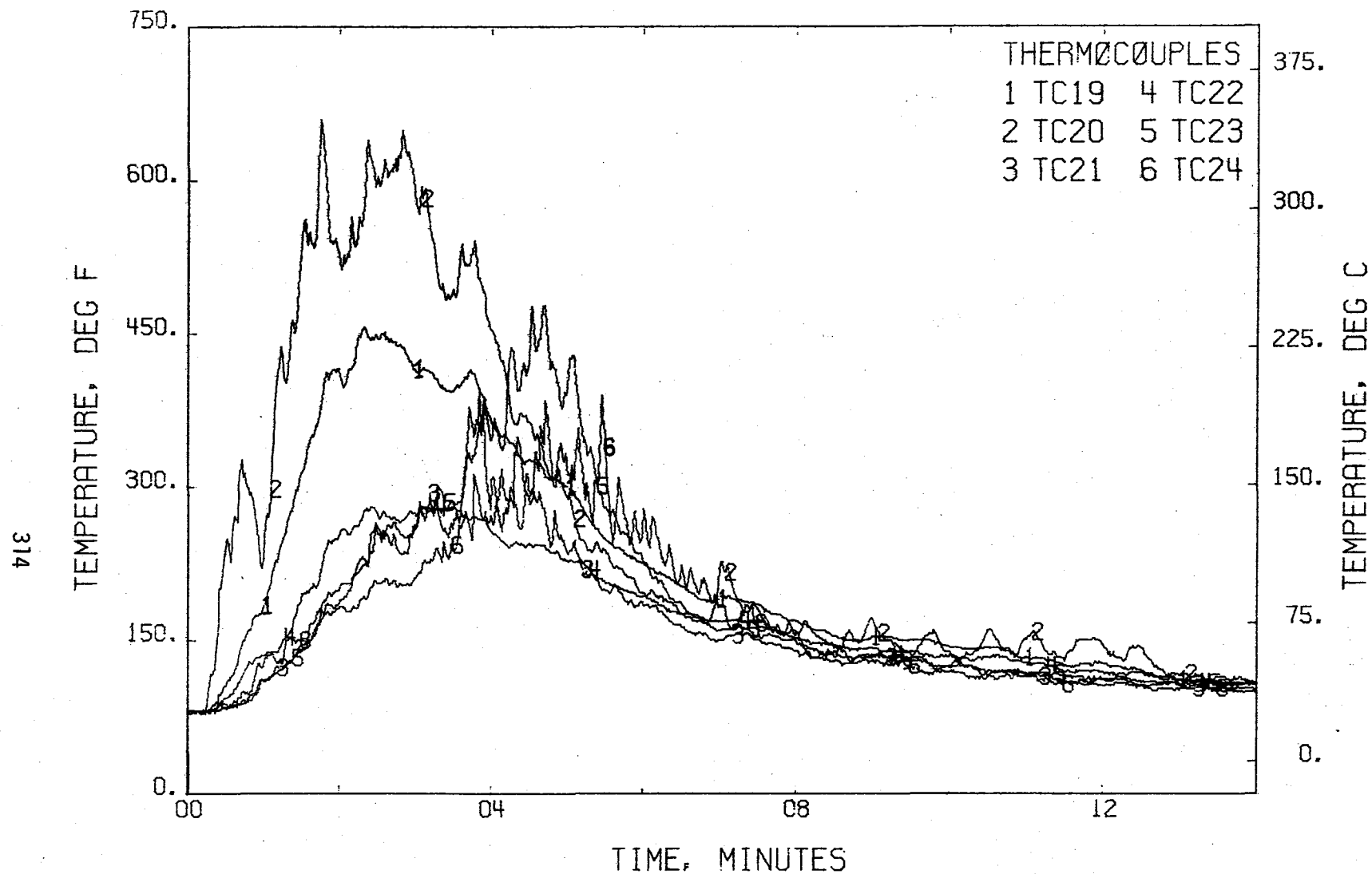


FIGURE 228 . - TEMPERATURES, T/C TREE 4  
TEST 14

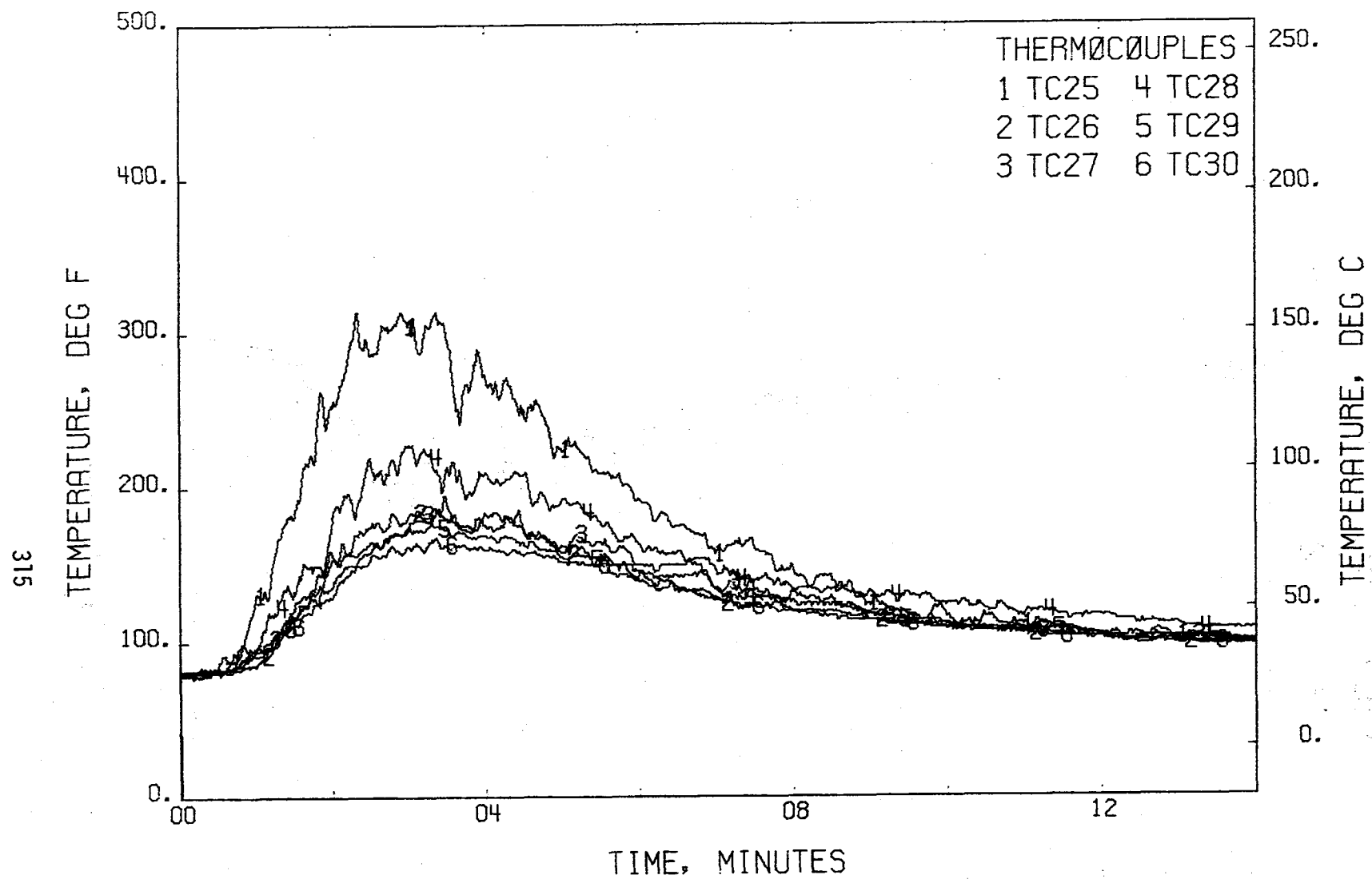


FIGURE 229 . - TEMPERATURES, T/C TREE 5  
TEST 14

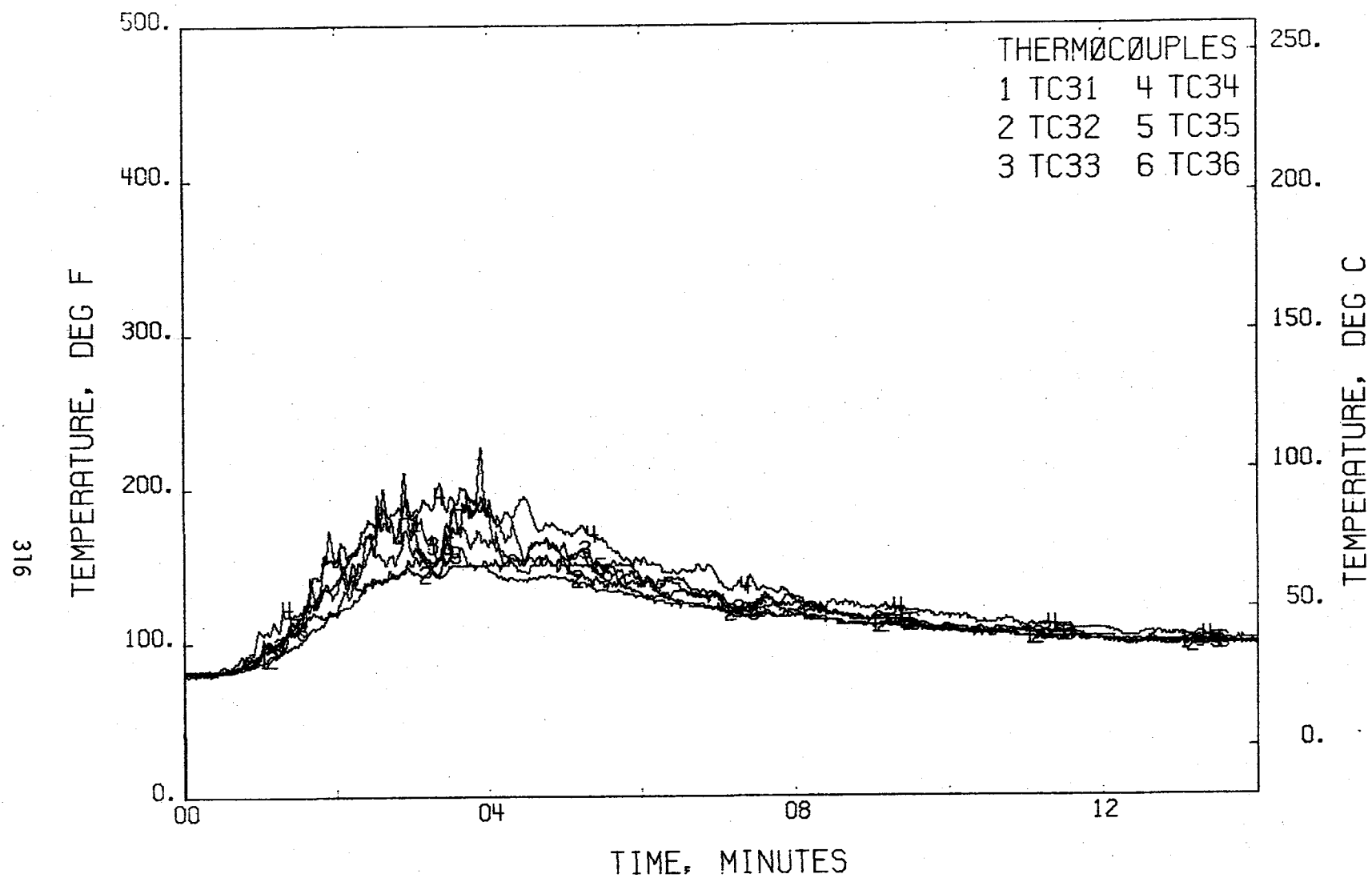


FIGURE 230 . - TEMPERATURES, T/C TREE 6  
TEST 14

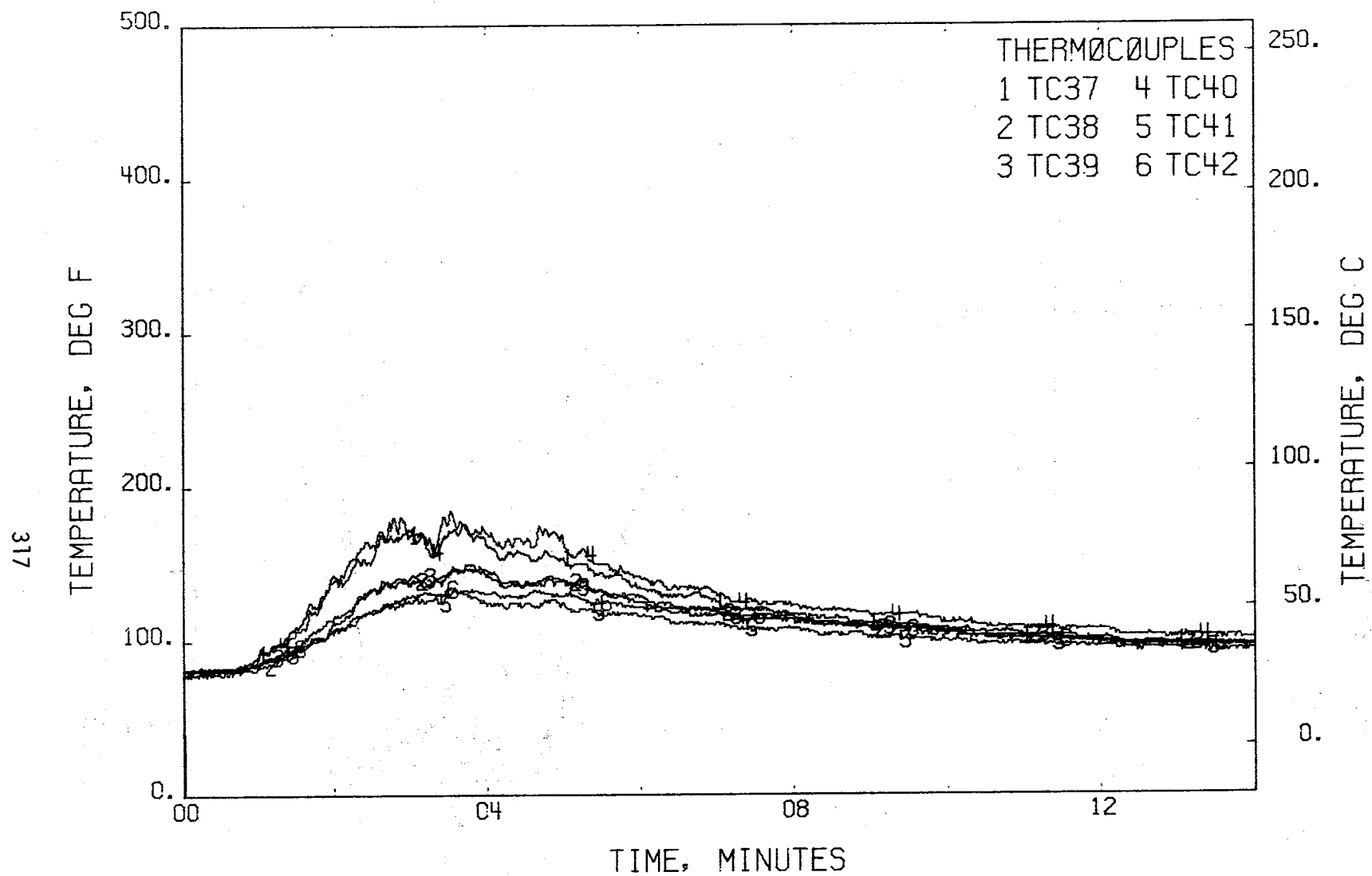


FIGURE 231 . - TEMPERATURES, T/C TREE 7  
TEST 14

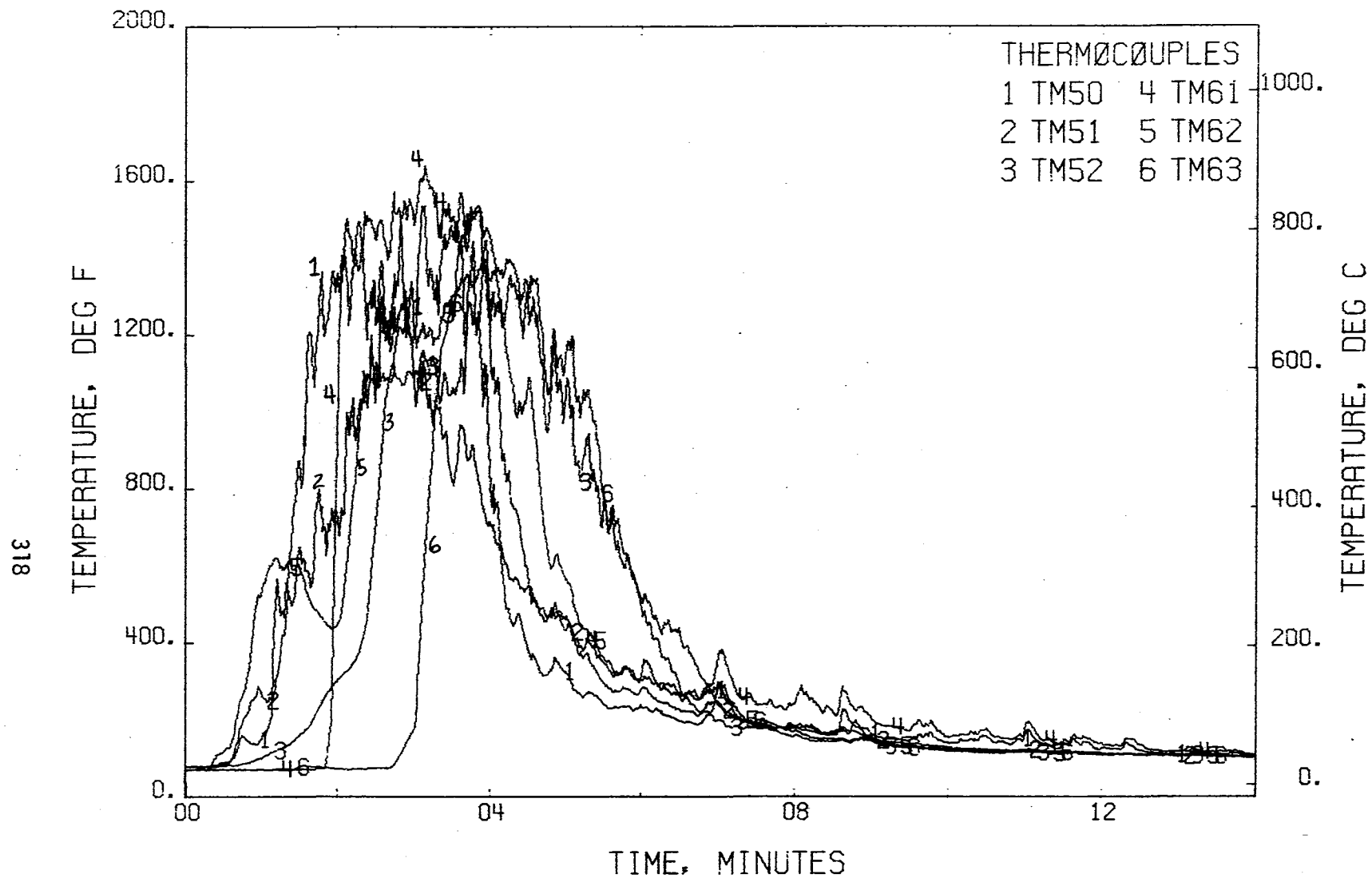


FIGURE 232 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 14

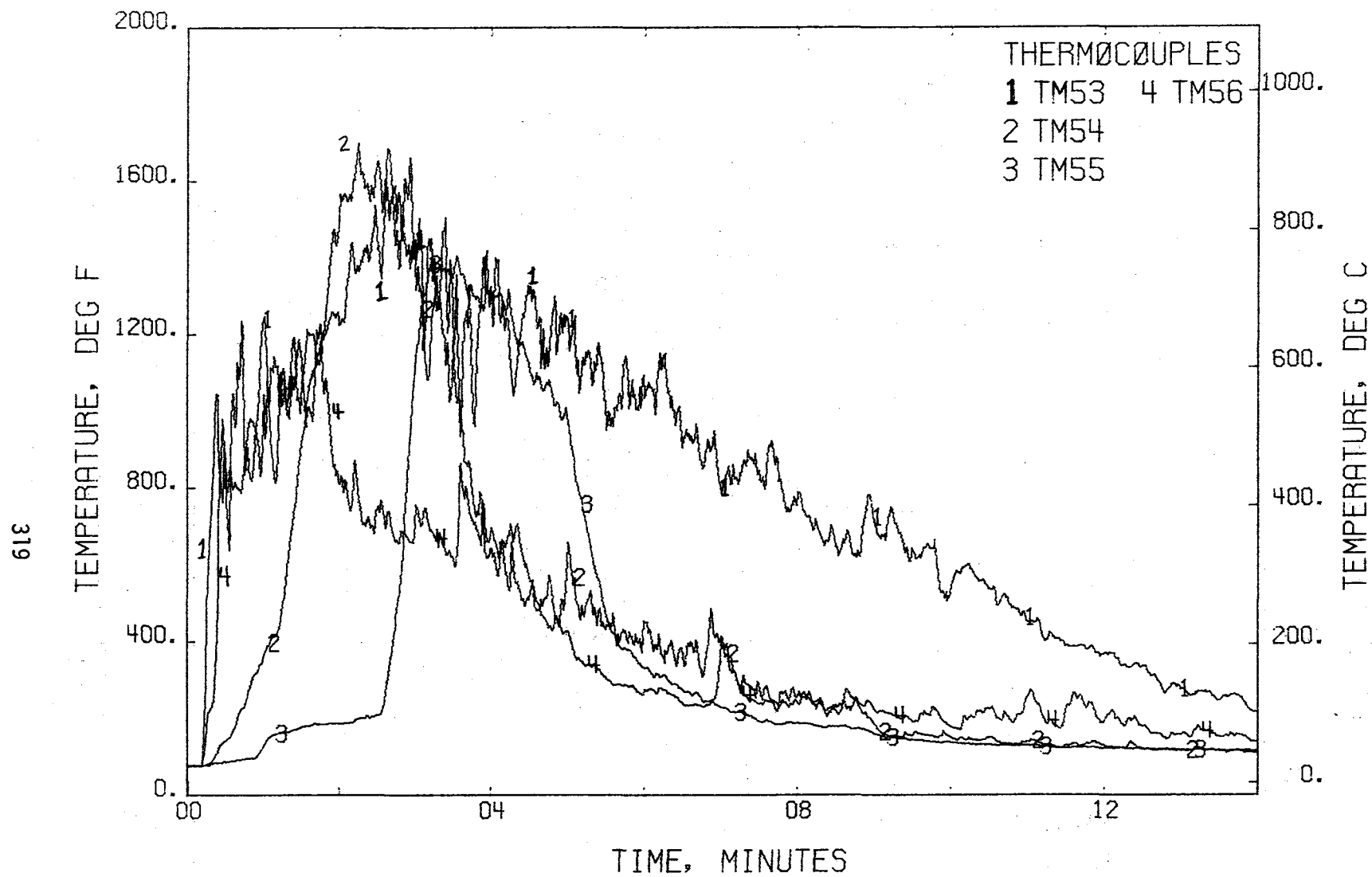


FIGURE 233 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 14

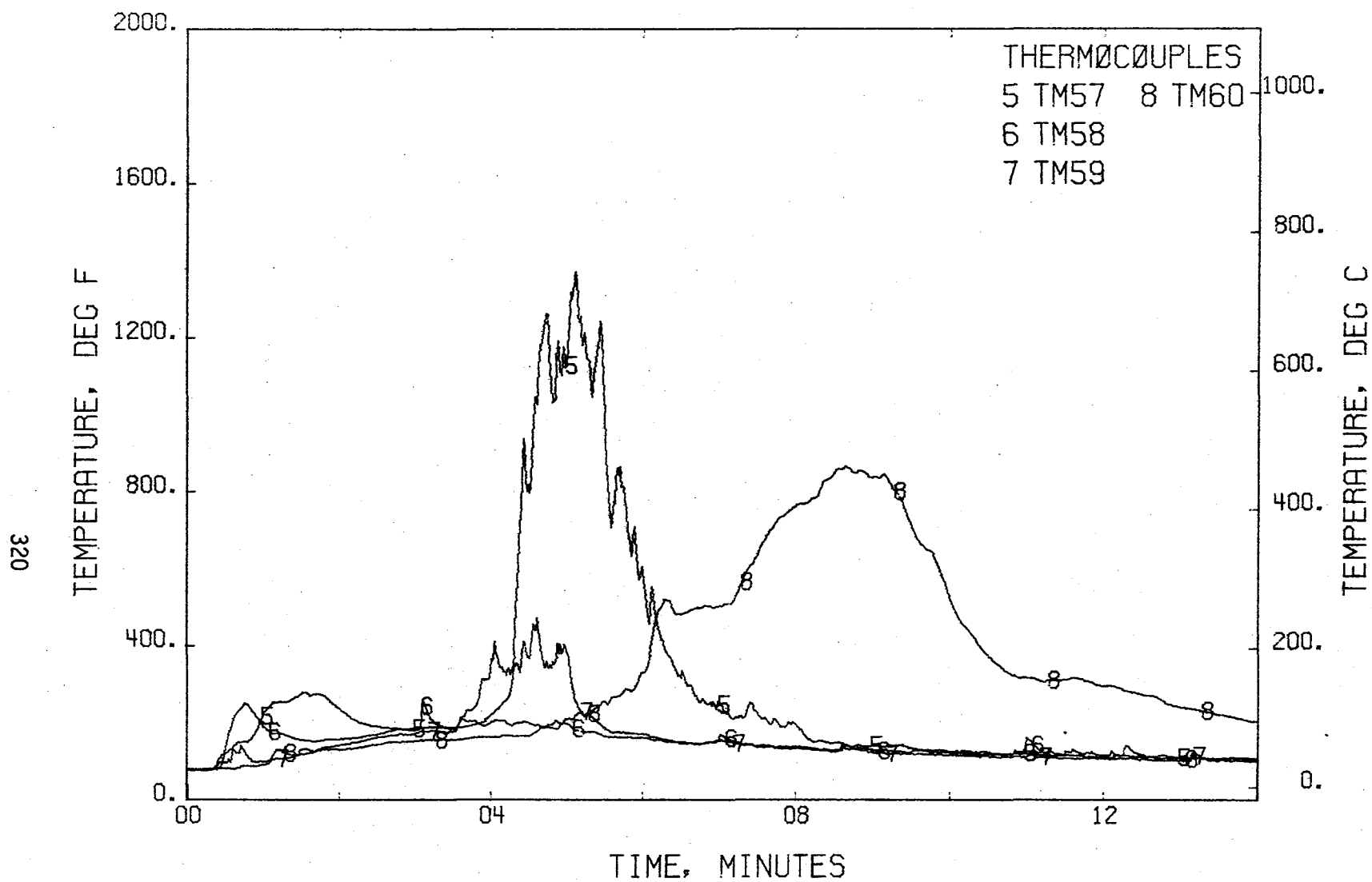


FIGURE 233 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 14



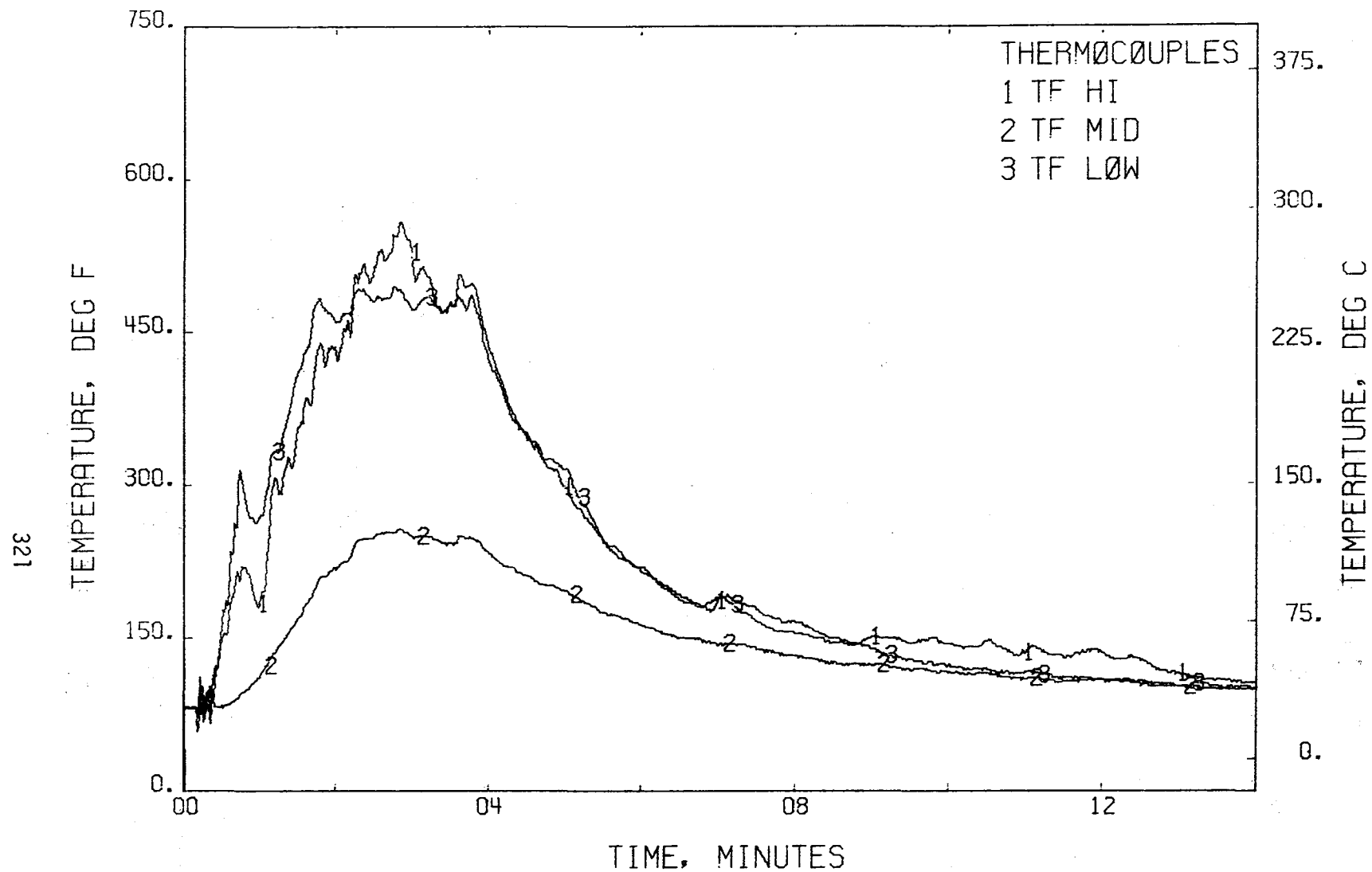


FIGURE 234 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 14

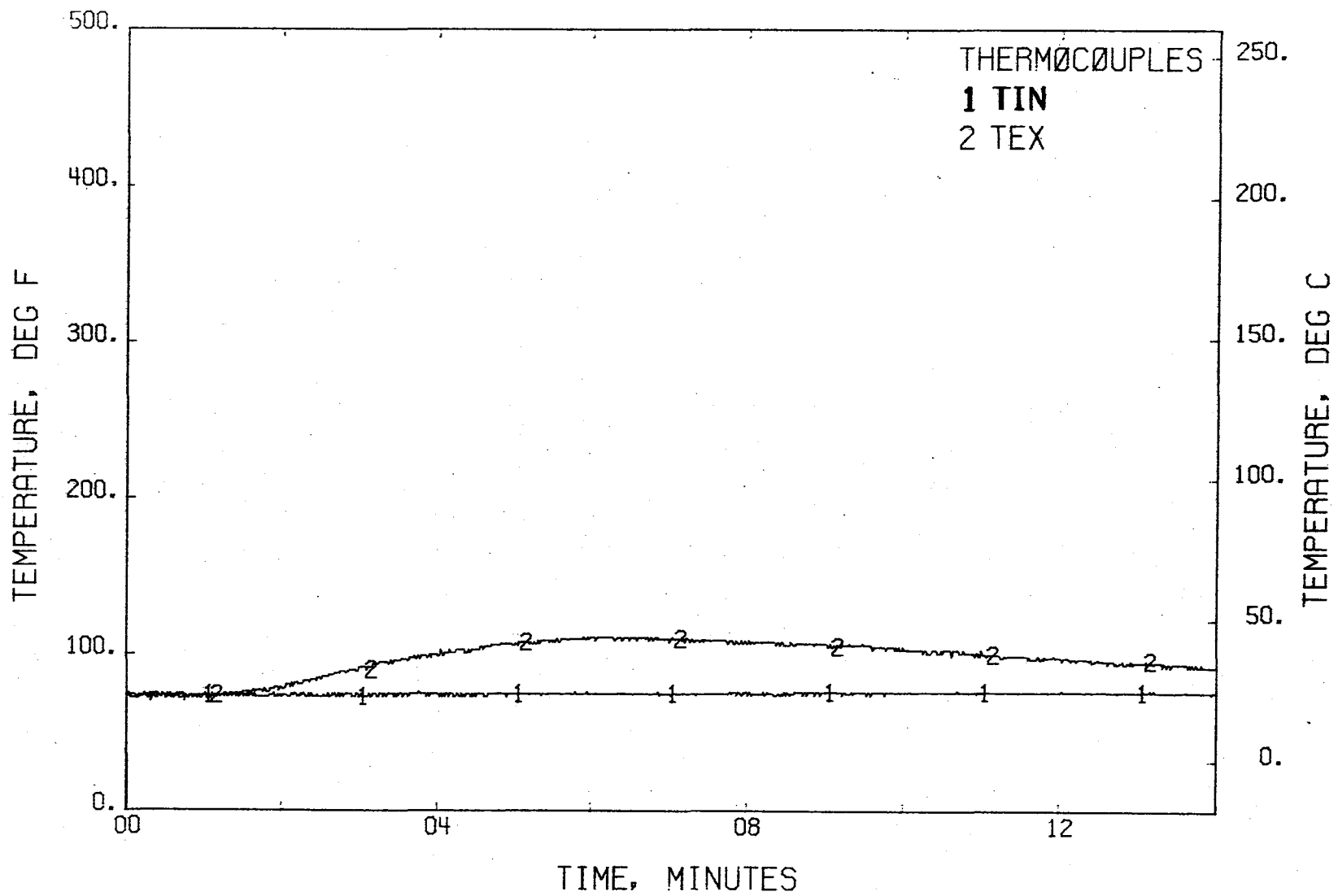


FIGURE 235 . - TEMPERATURES, INLET + EXIT  
TEST 14

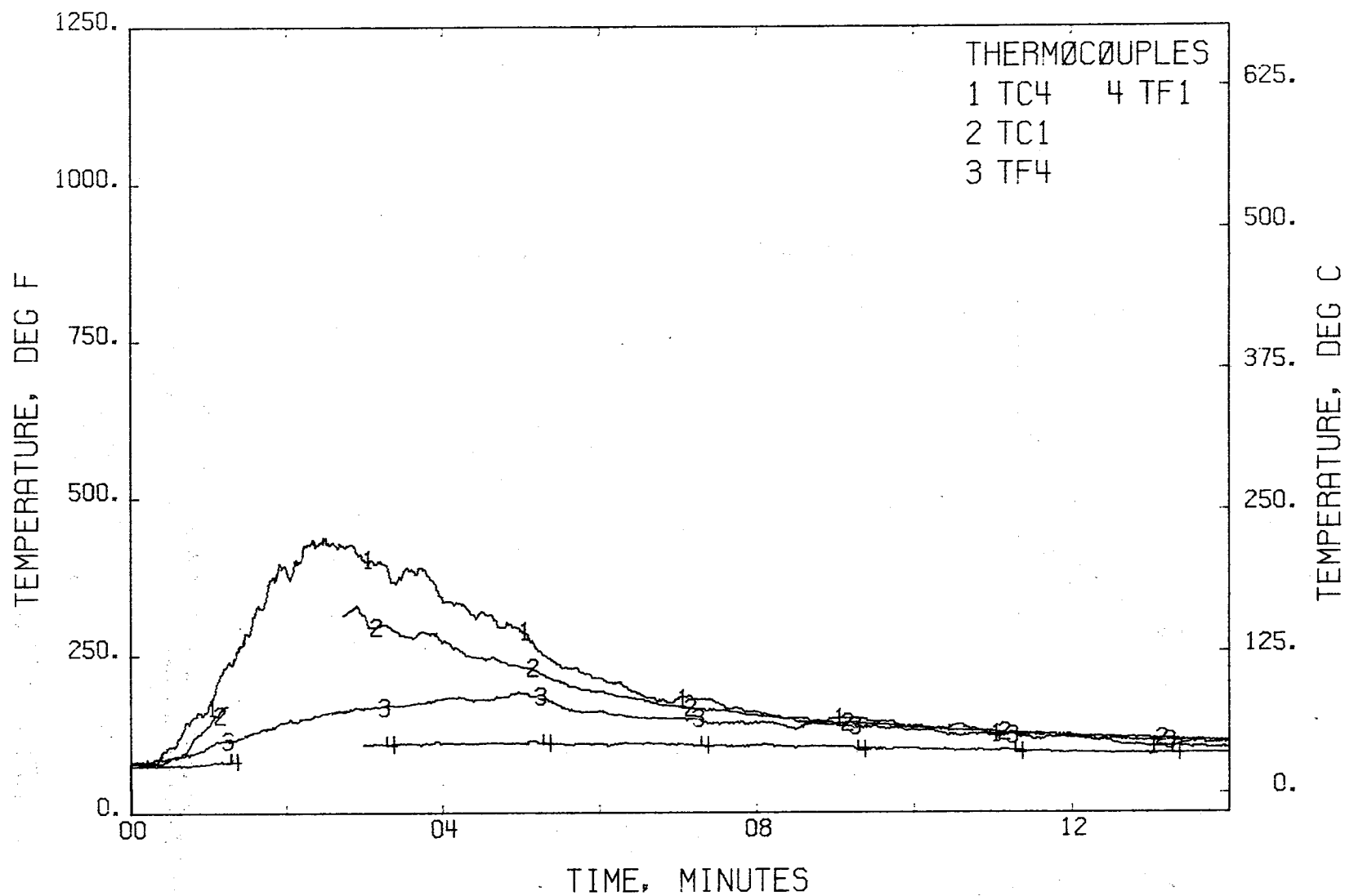


FIGURE 236 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 14

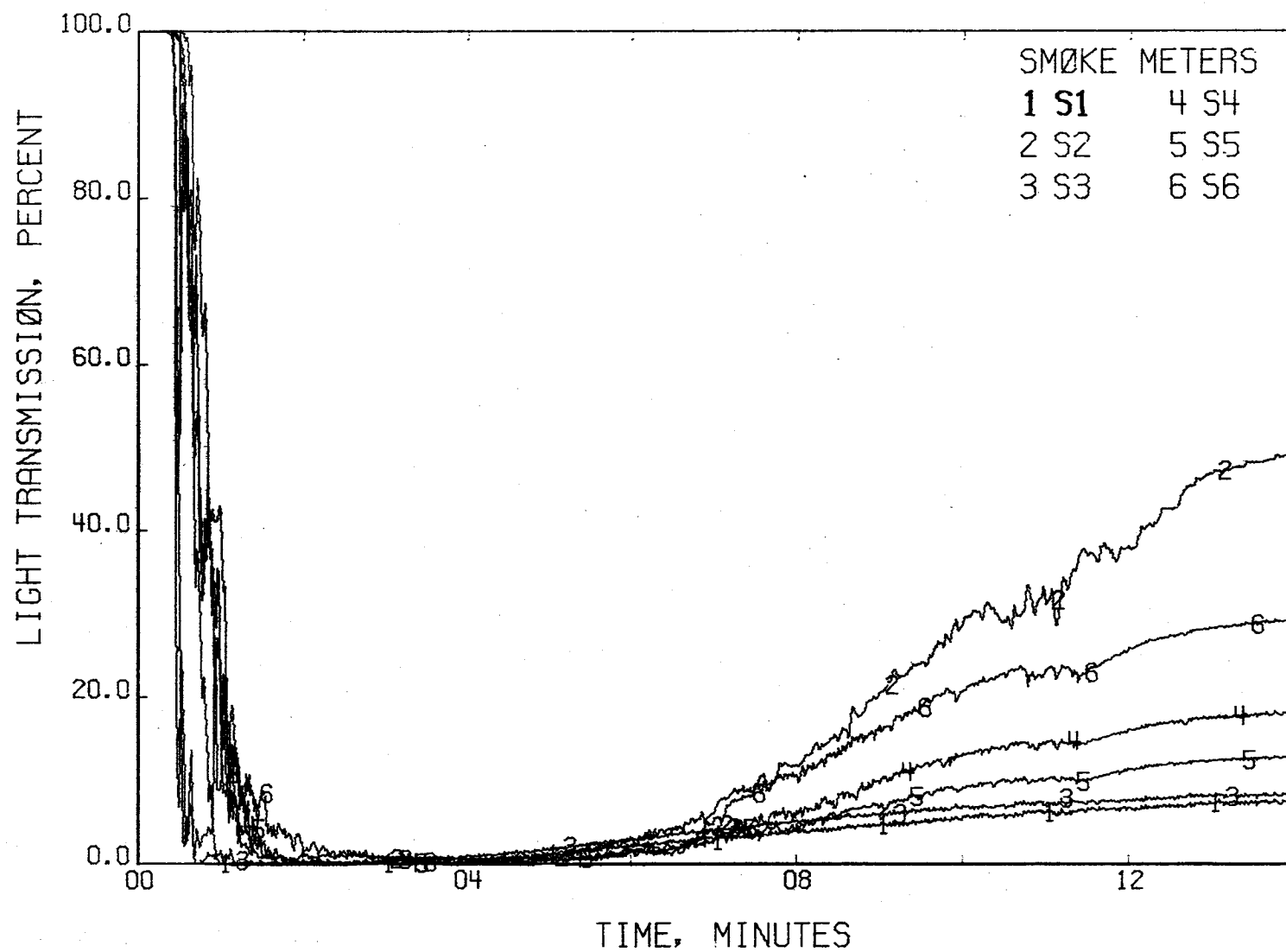


FIGURE 237 . - LIGHT TRANSMISSION  
TEST 14

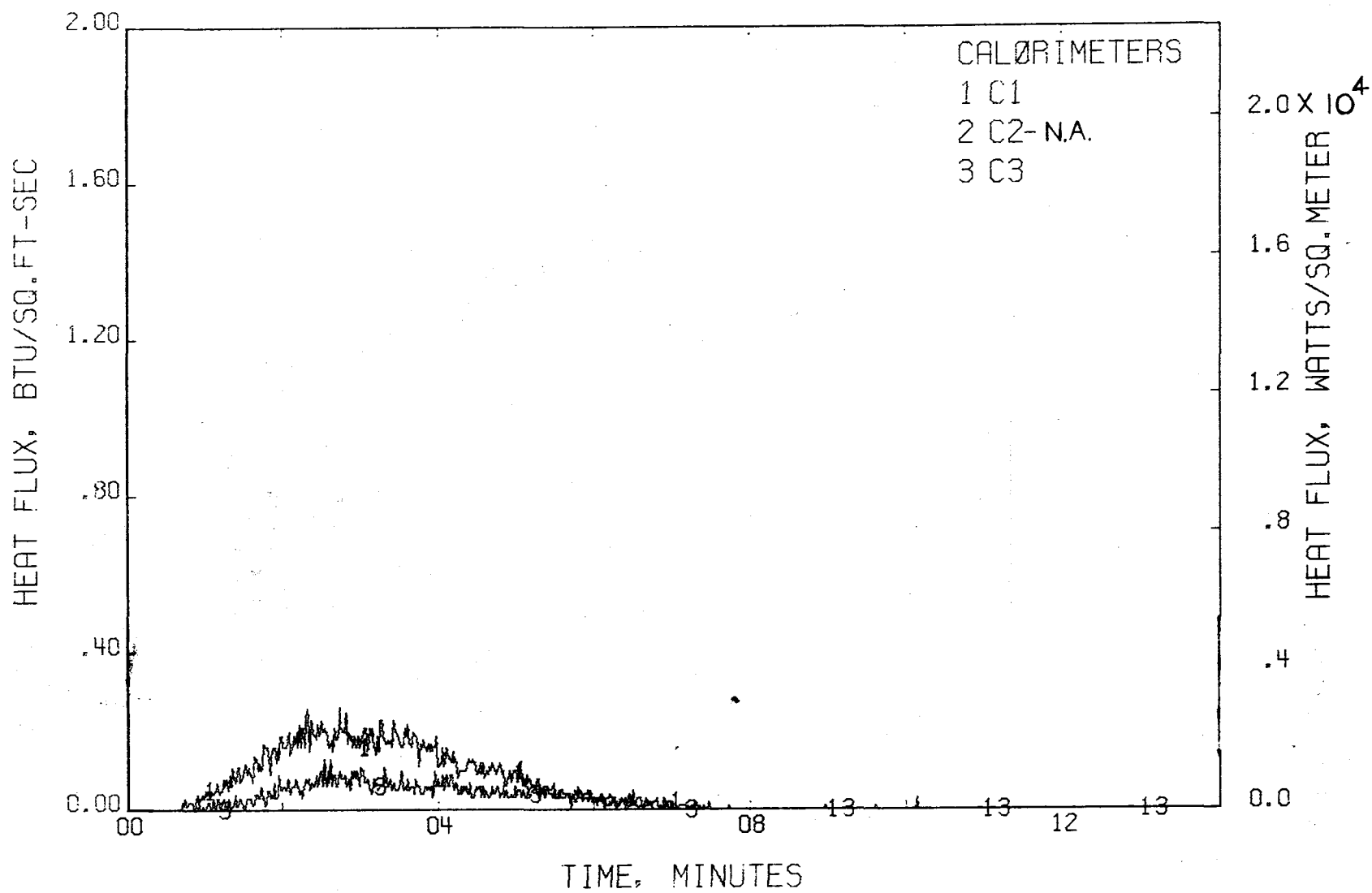


FIGURE 238 . - HEAT FLUX, AFT  
TEST 14

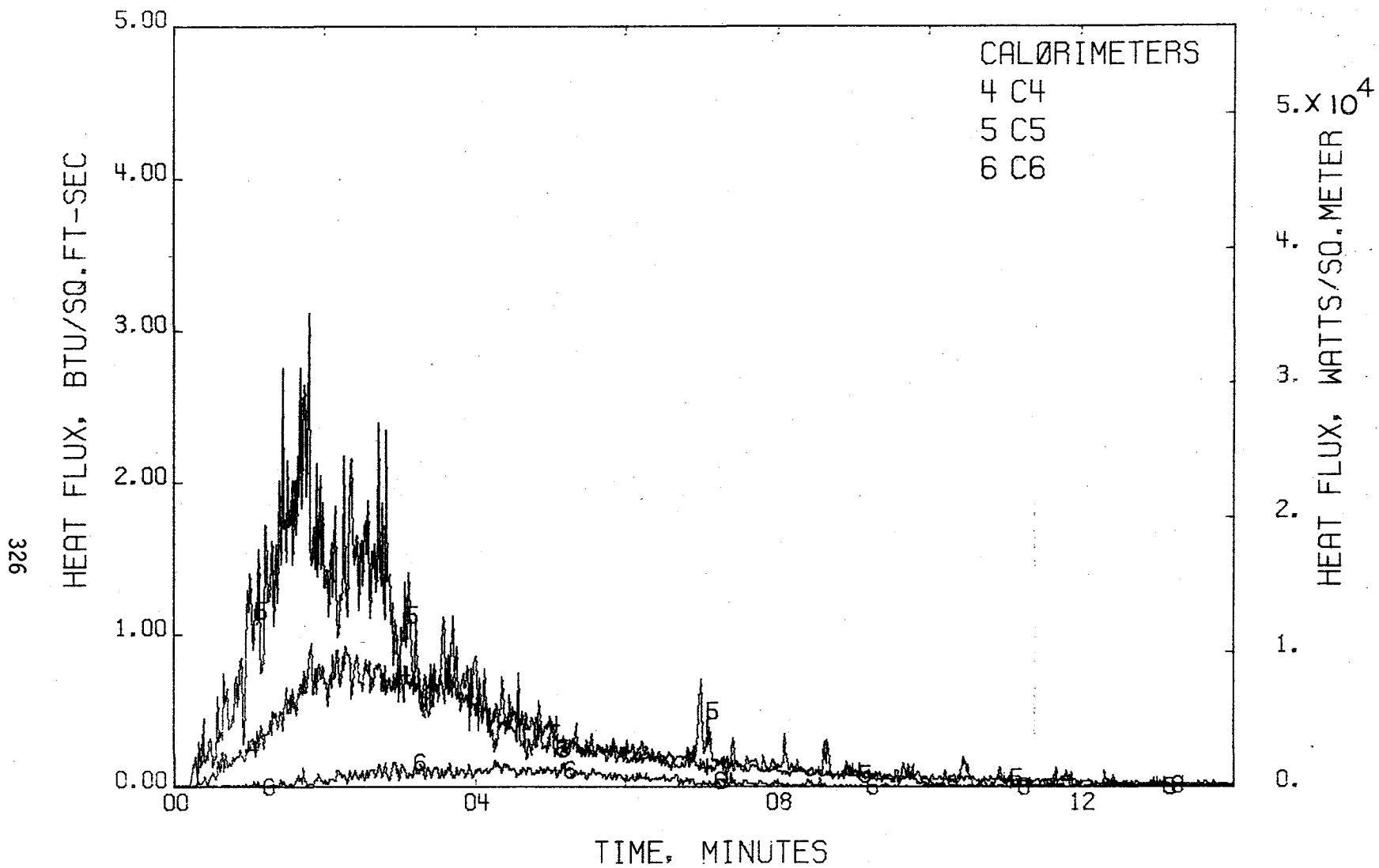


FIGURE 239 . - HEAT FLUX, MIDSECTION  
TEST 14

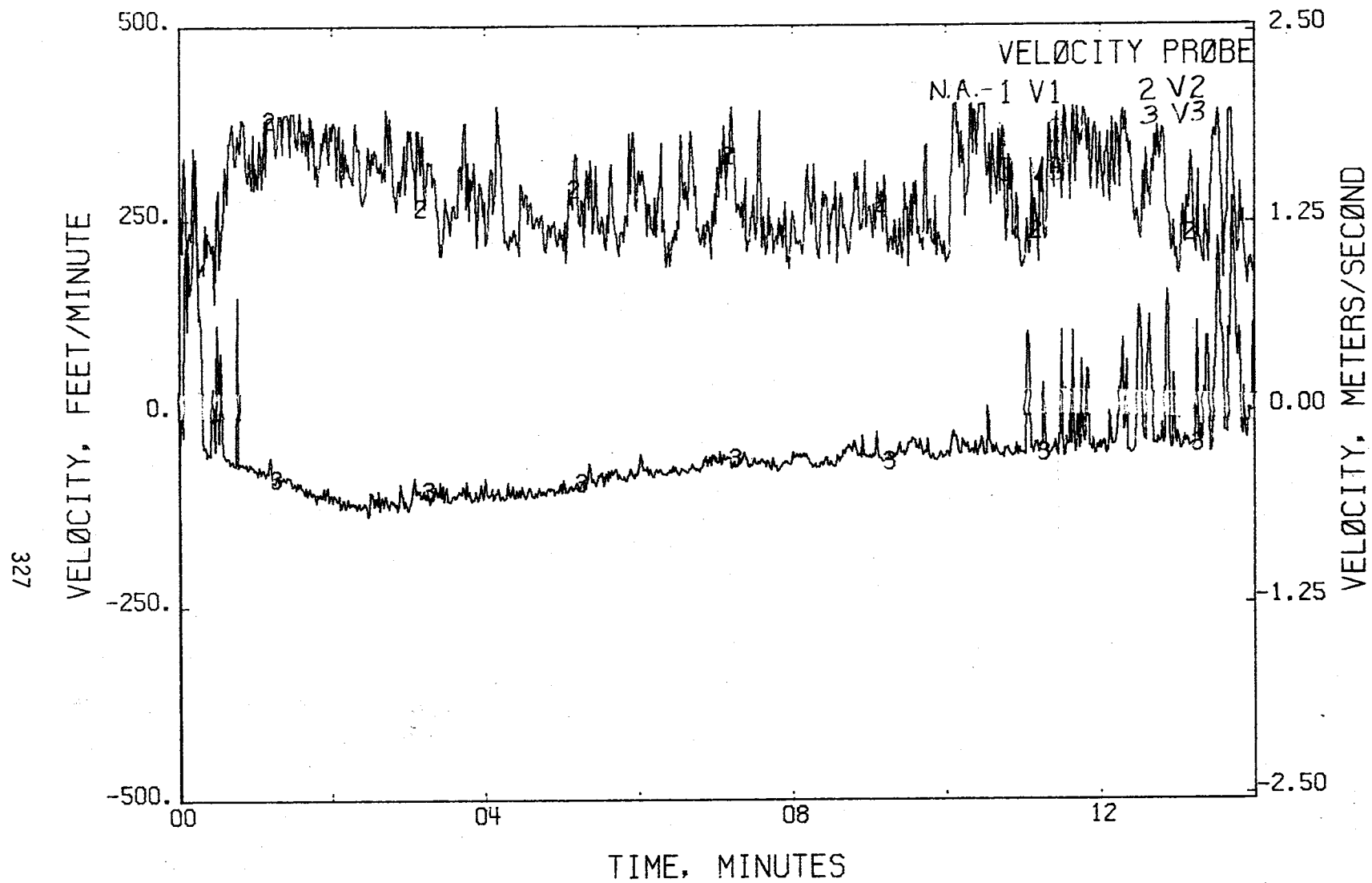


FIGURE 240 . - AIR VELOCITY  
TEST 14

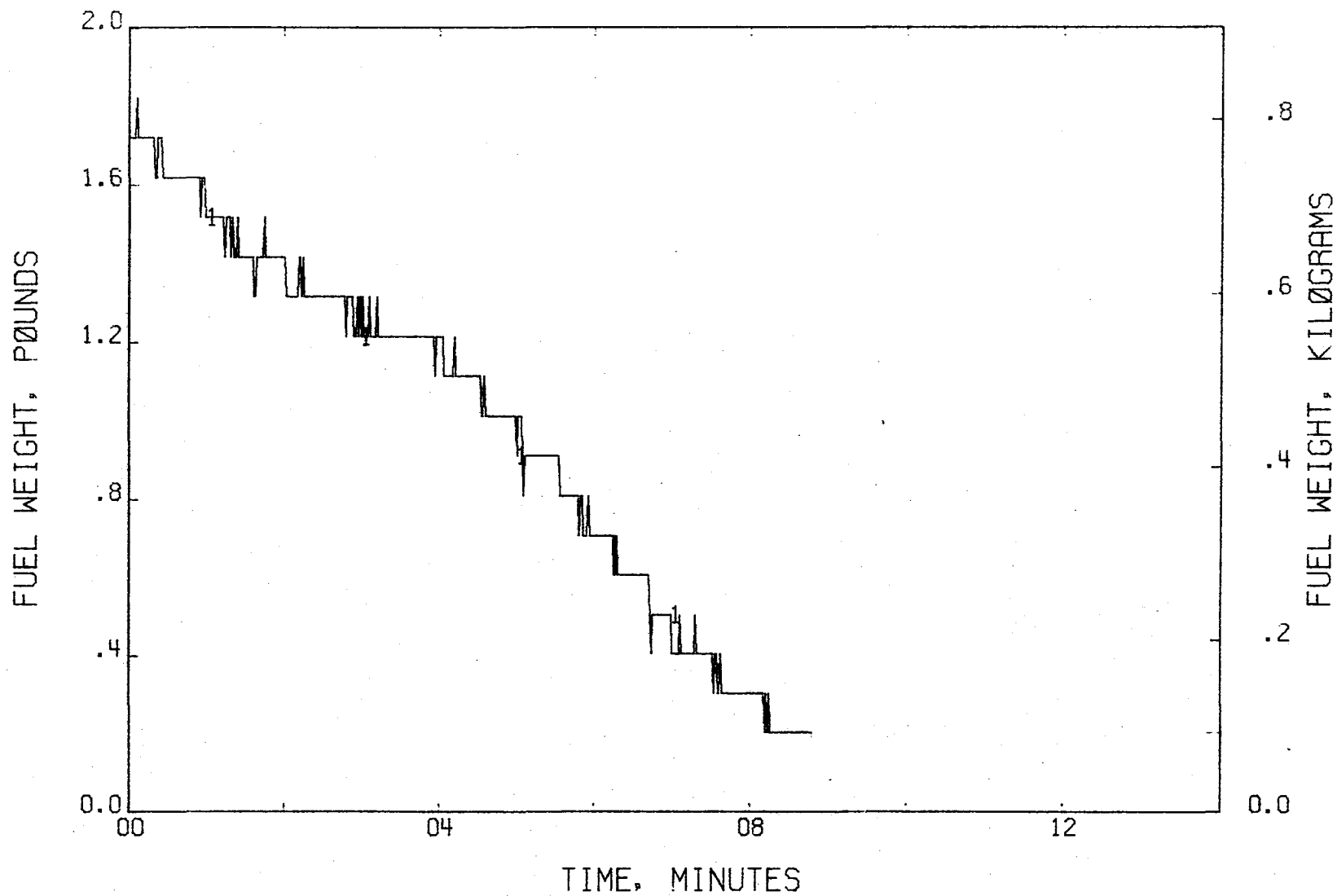


FIGURE 241 . - FUEL WEIGHT LOSS  
TEST 14



329

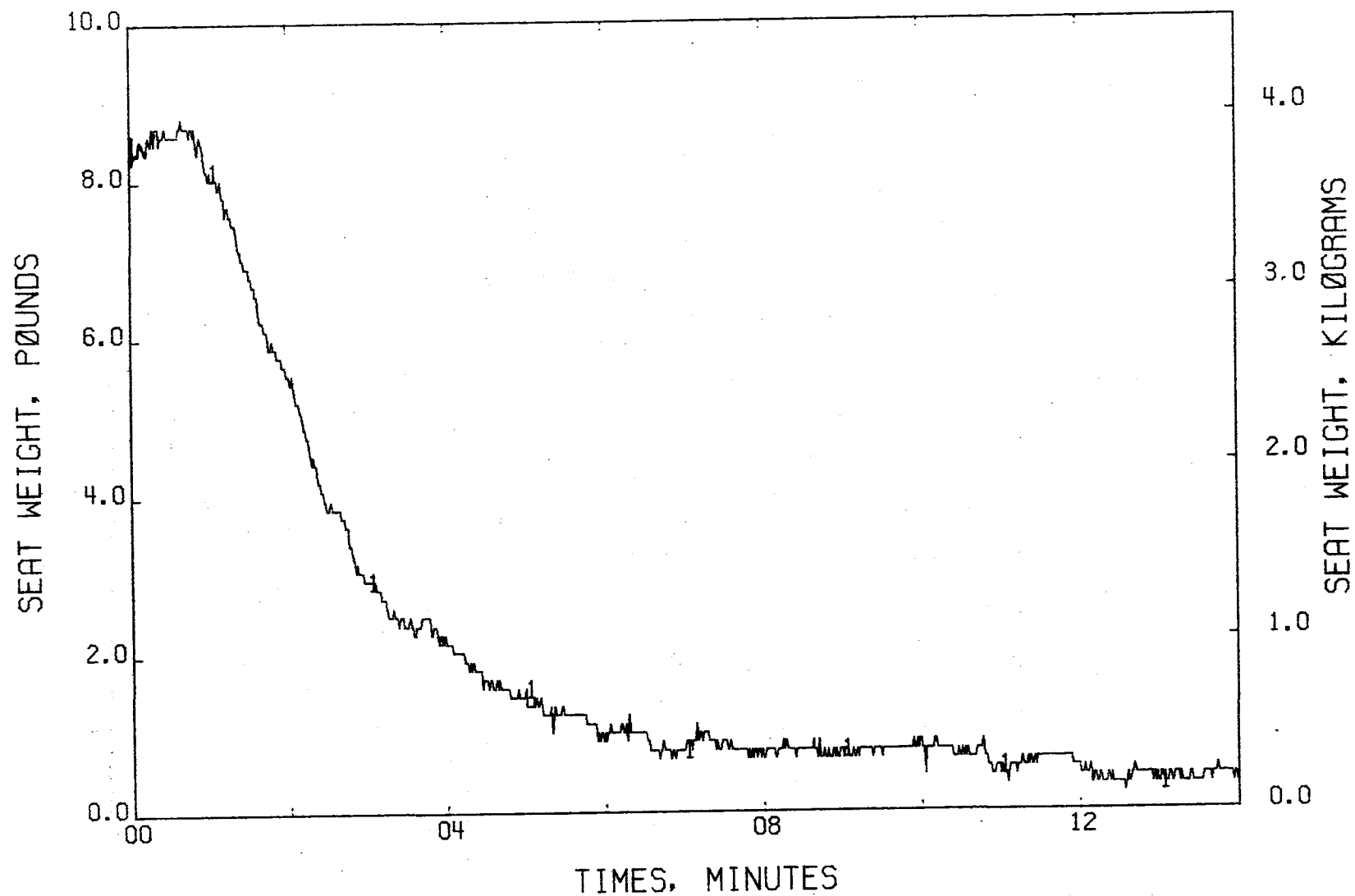


FIGURE 242 . - SEAT WEIGHT LOSS  
TEST 14

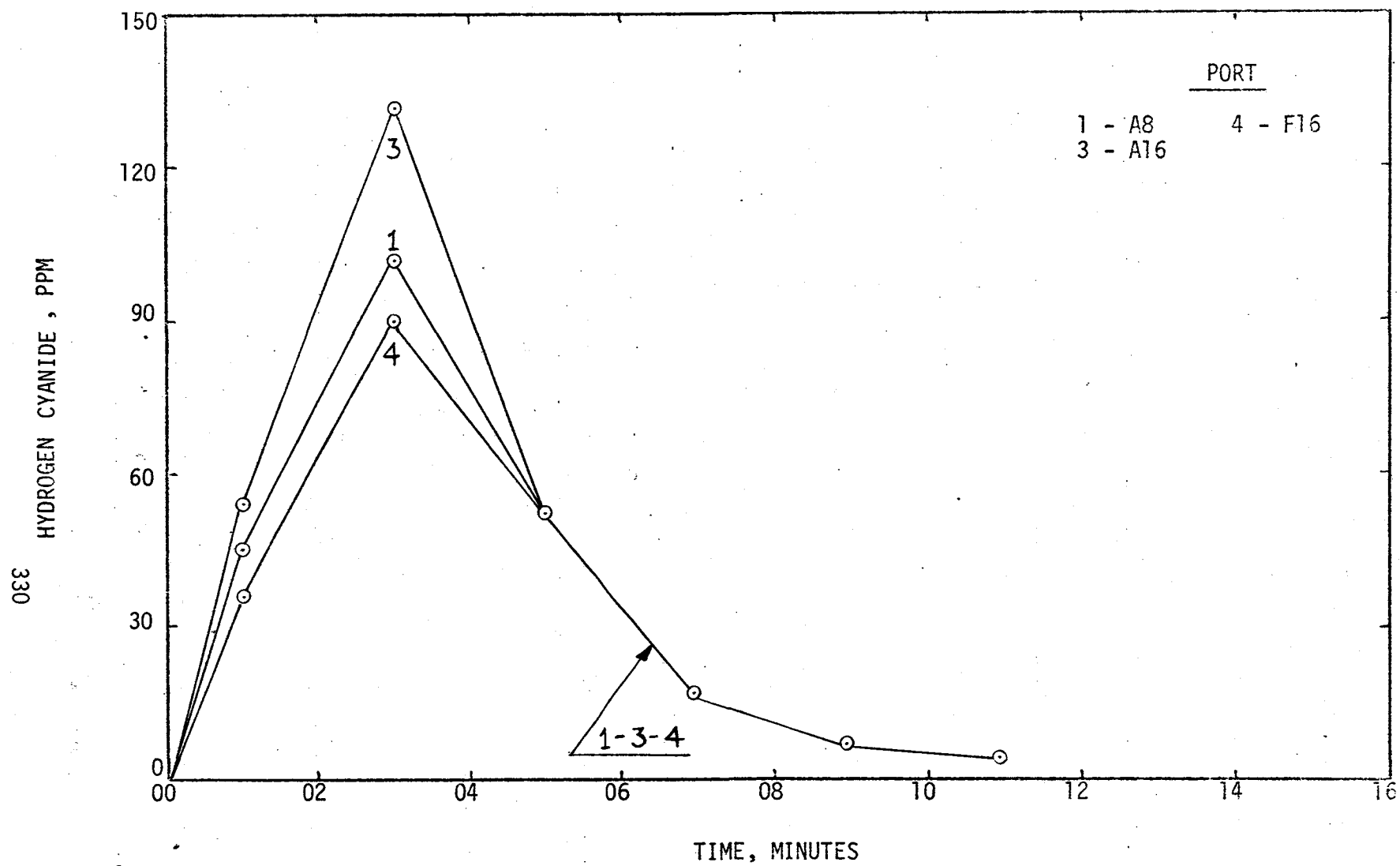


FIGURE 243 : - HYDROGEN CYANIDE CONCENTRATIONS  
TEST 14

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 3 PPM

FIGURE 244 . - HYDROGEN FLUORIDE CONCENTRATIONS  
TEST 14

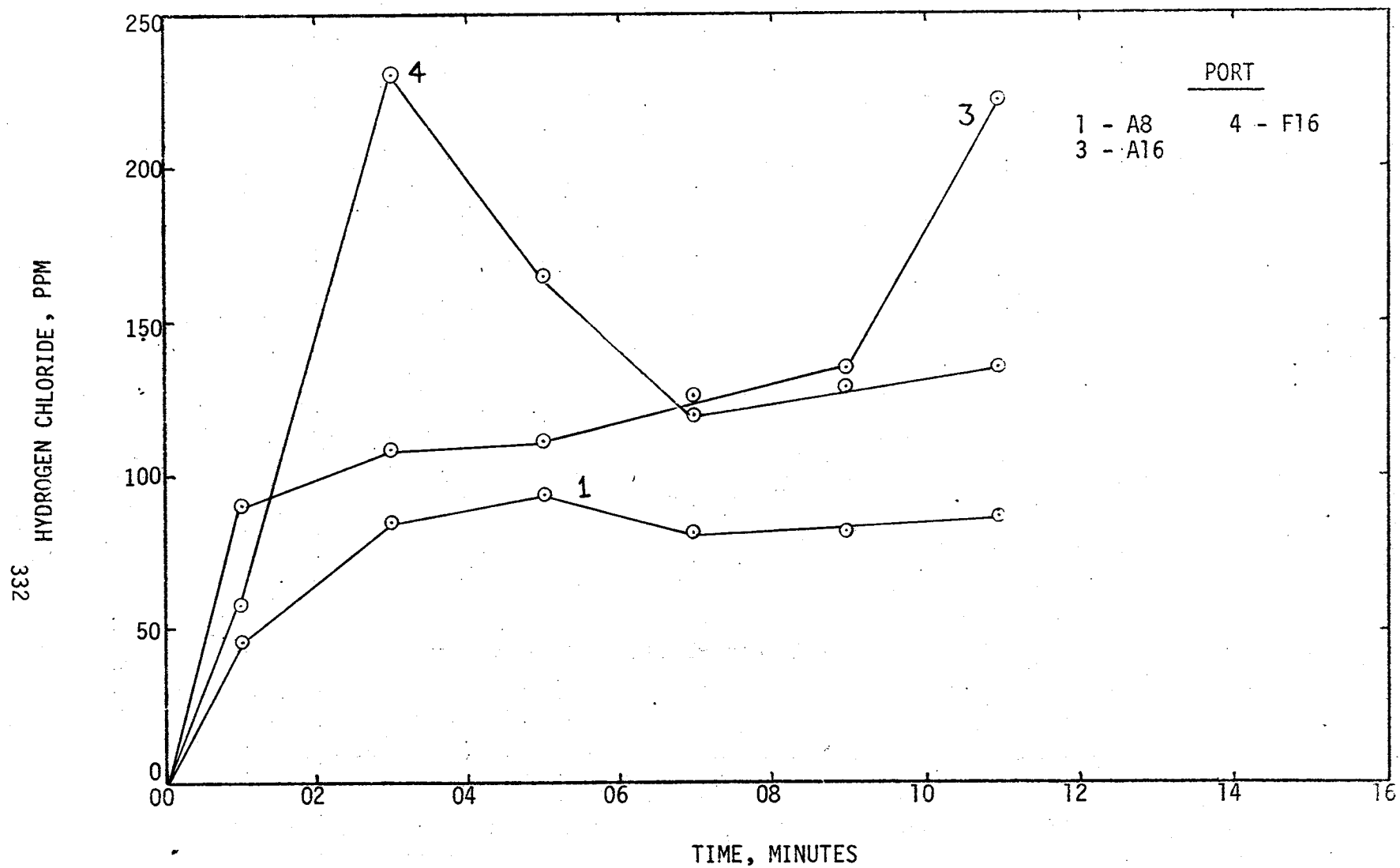


FIGURE 245 : - HYDROGEN CHLORIDE CONCENTRATIONS  
TEST 14

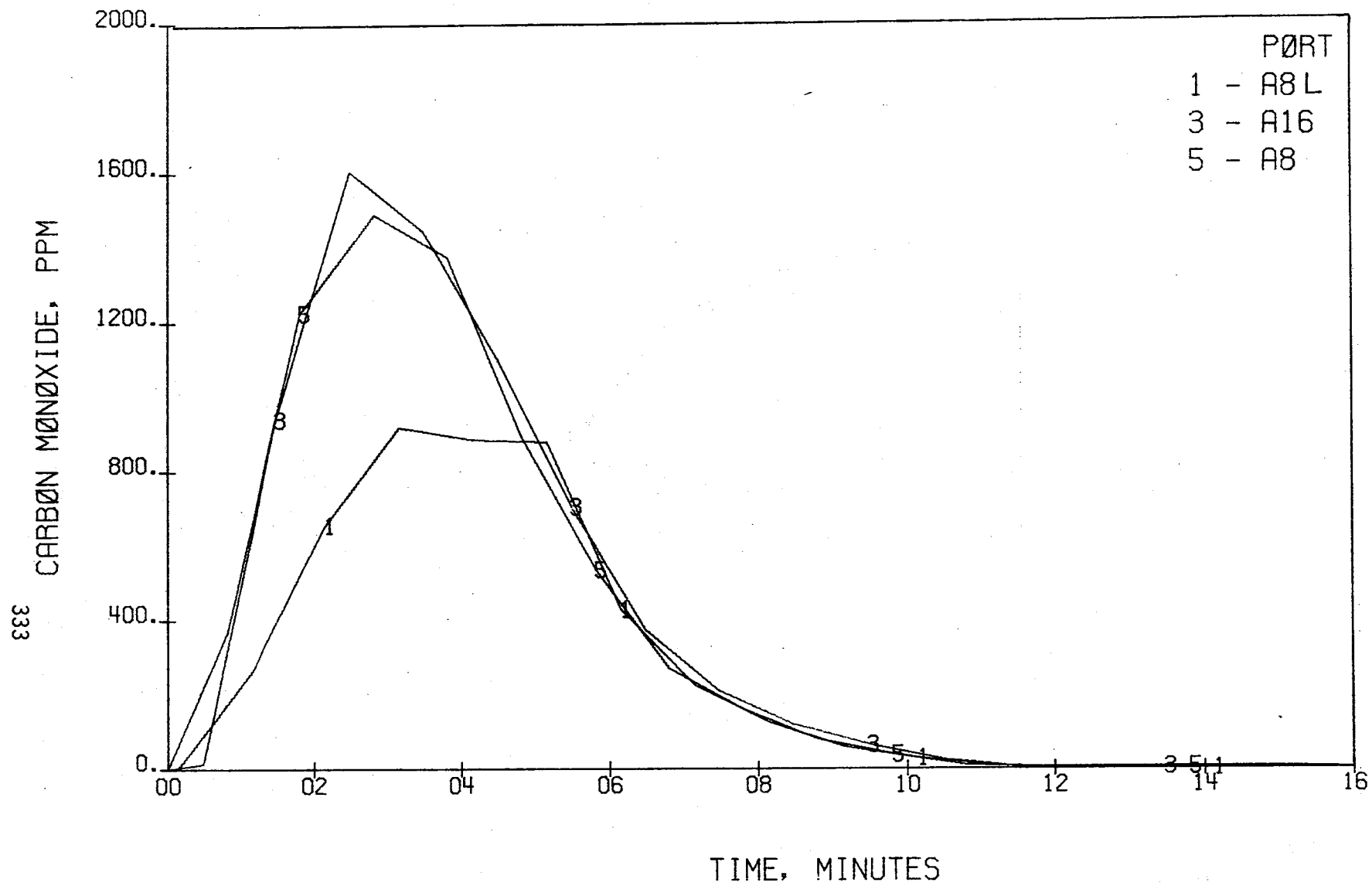


FIGURE 246 . - CARBON MONOXIDE CONCENTRATIONS , AFT  
TEST 14

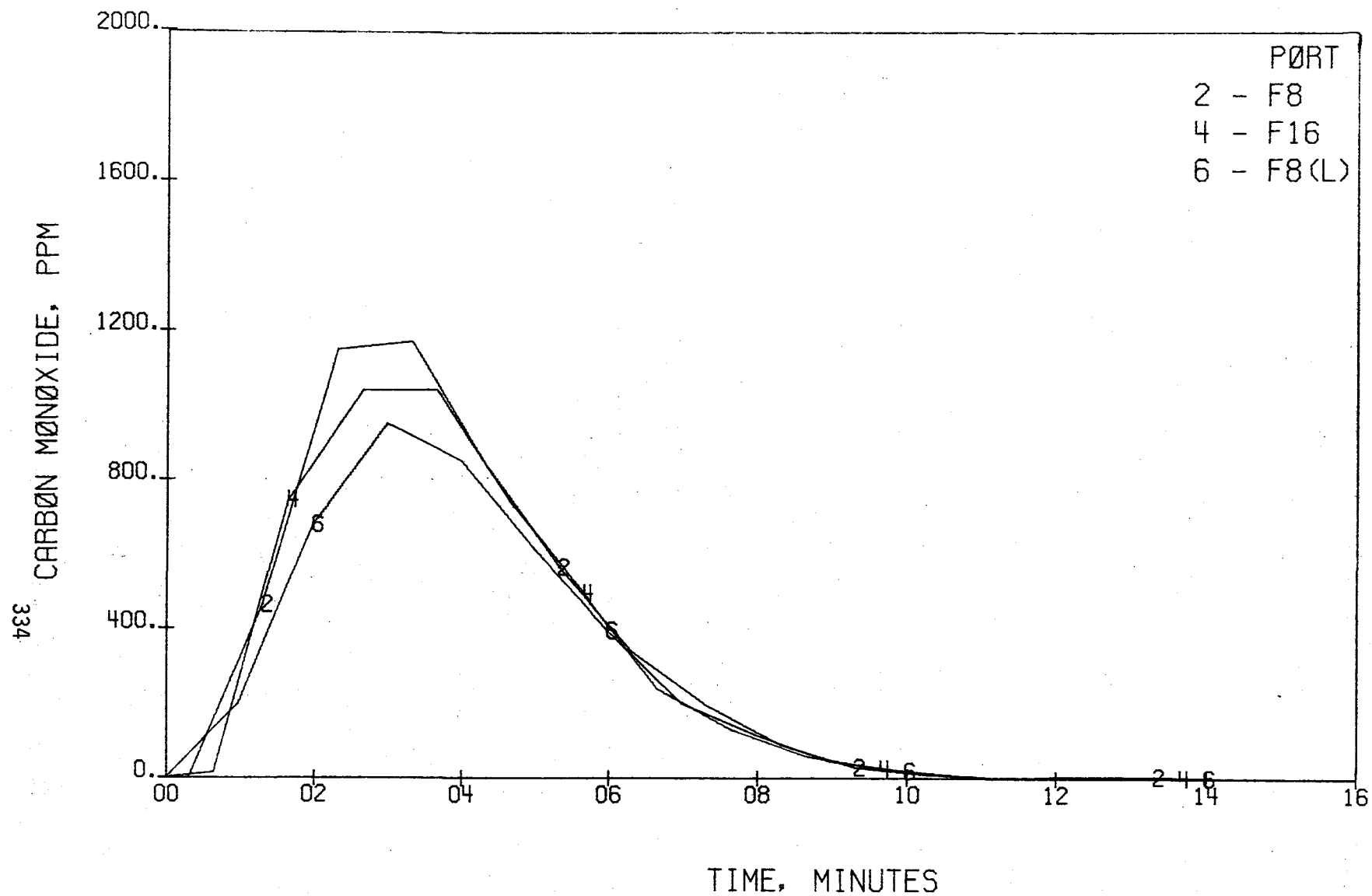


FIGURE 247 . - CARBON MONOXIDE CONCENTRATIONS, FØRE  
TEST 14

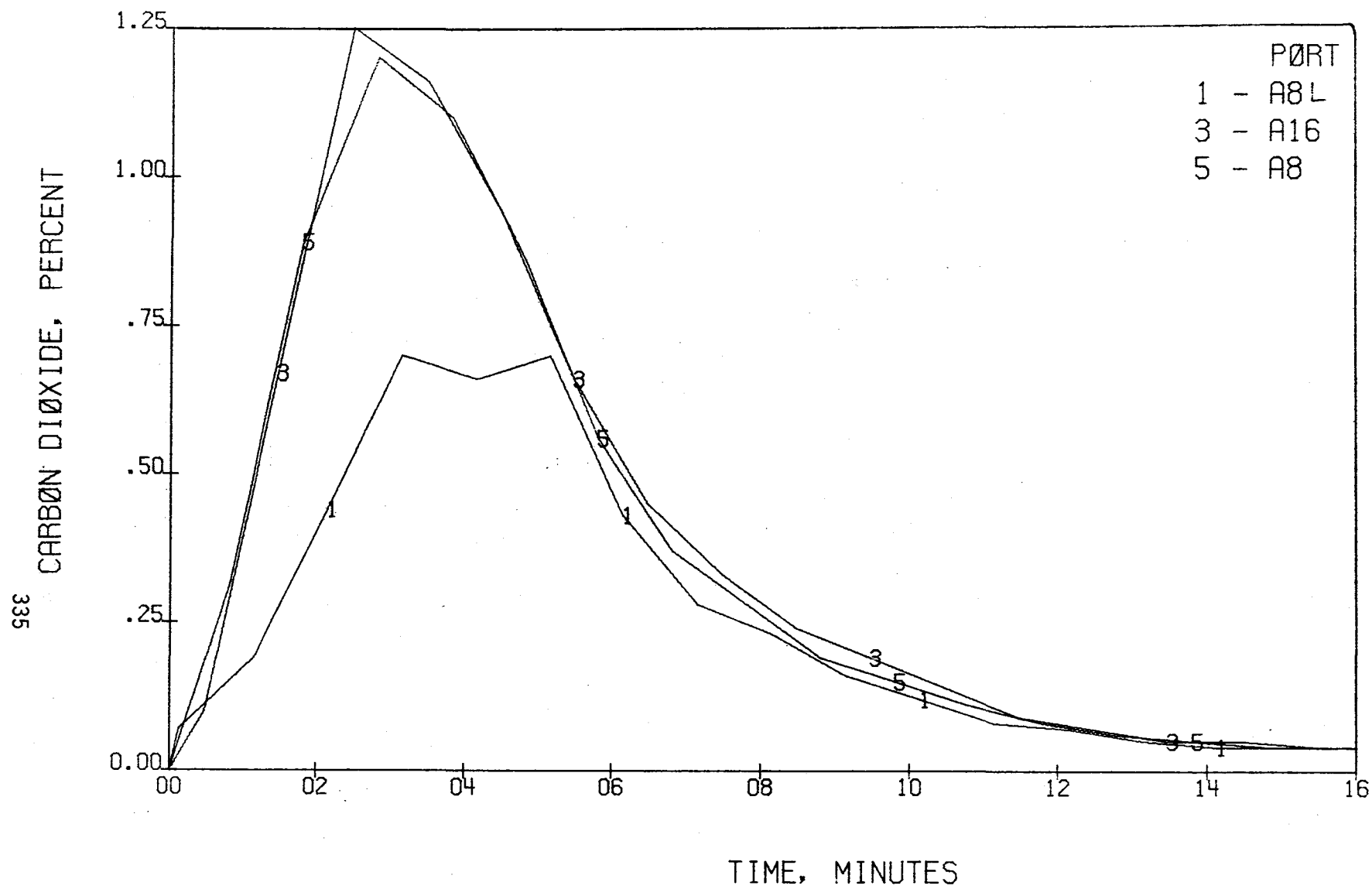


FIGURE 248 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 14

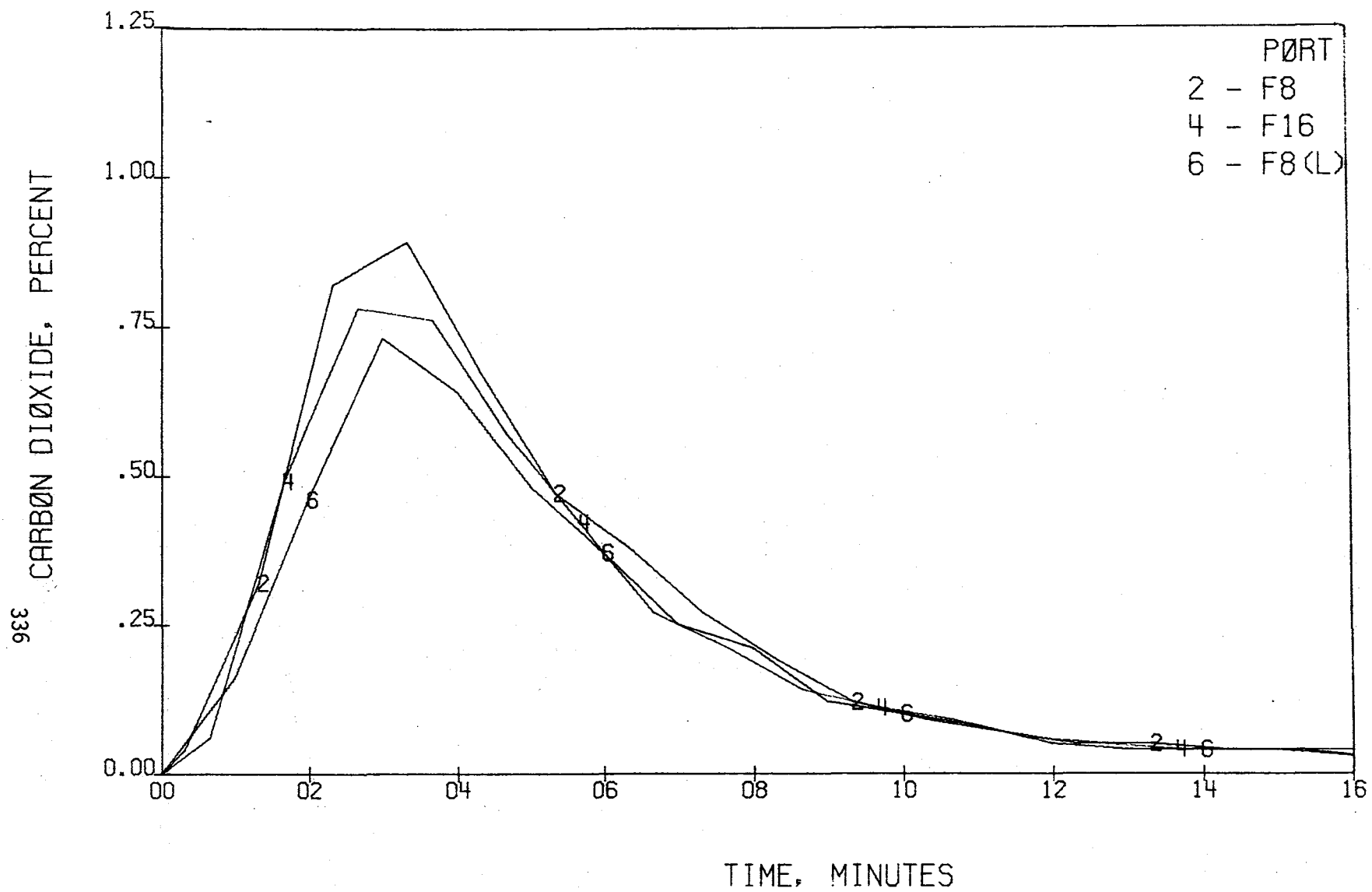


FIGURE 249 . - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 14



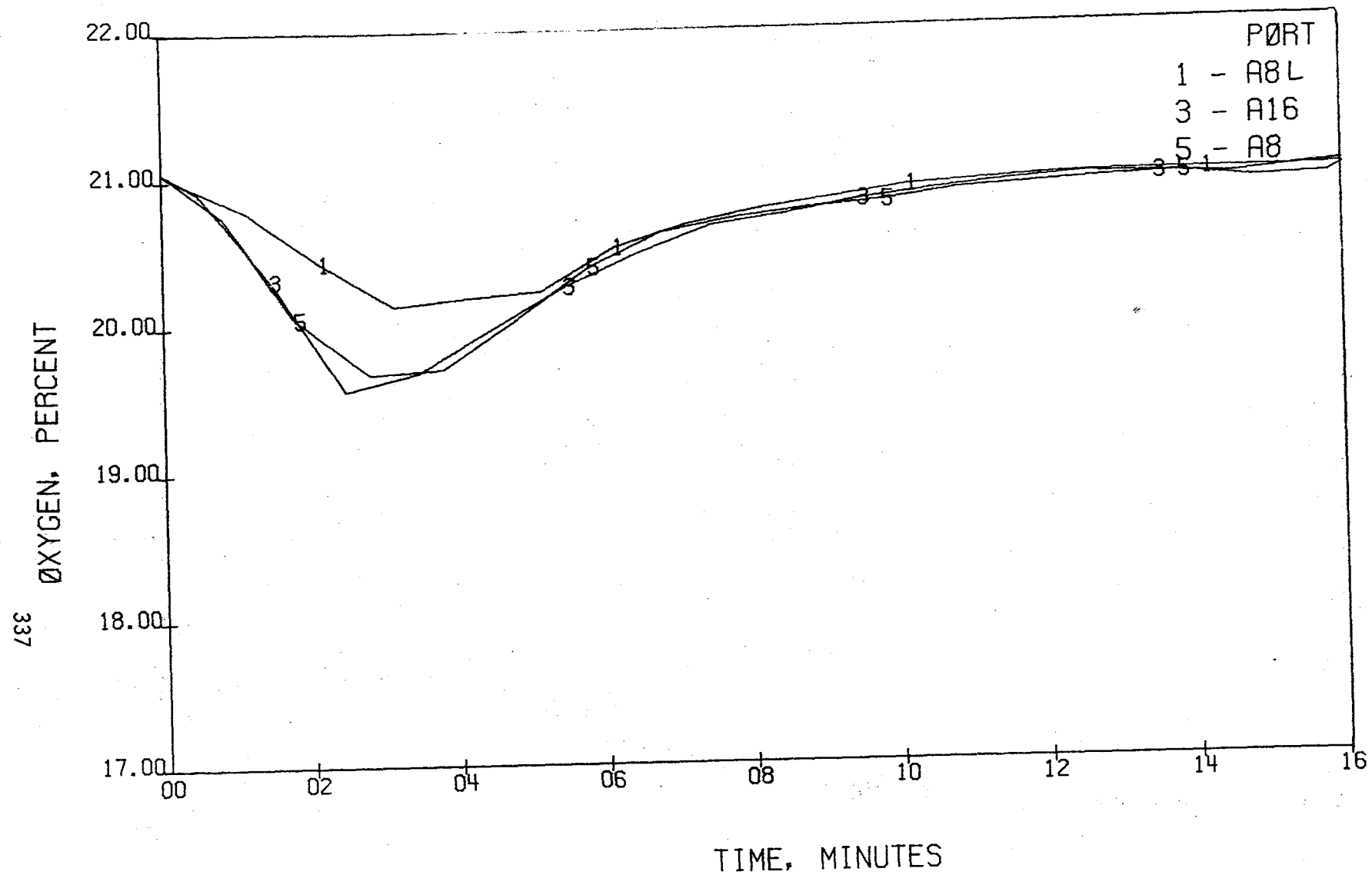


FIGURE 250 . - OXYGEN CONCENTRATIONS , AFT  
TEST 14

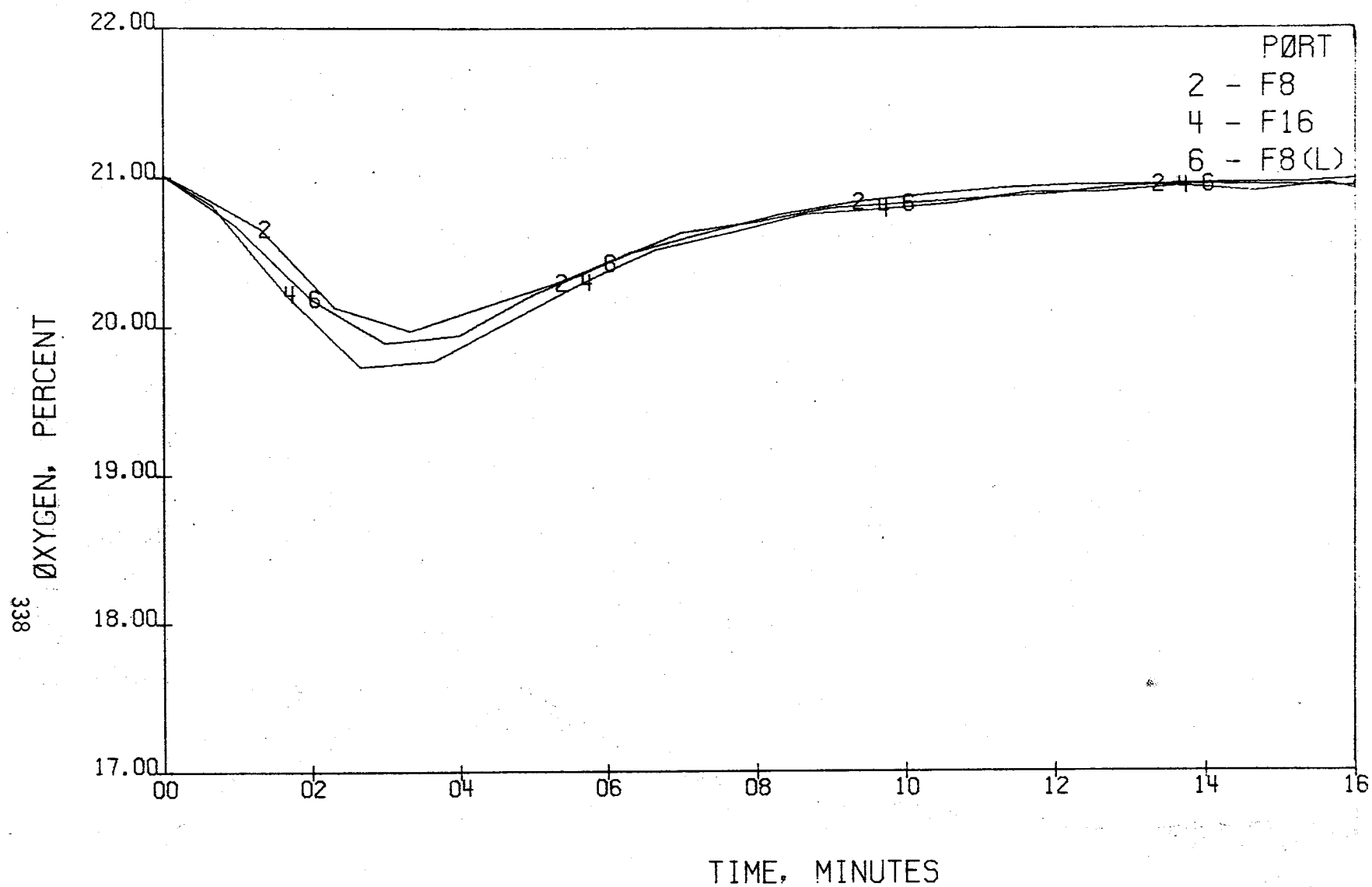


FIGURE 251 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 14

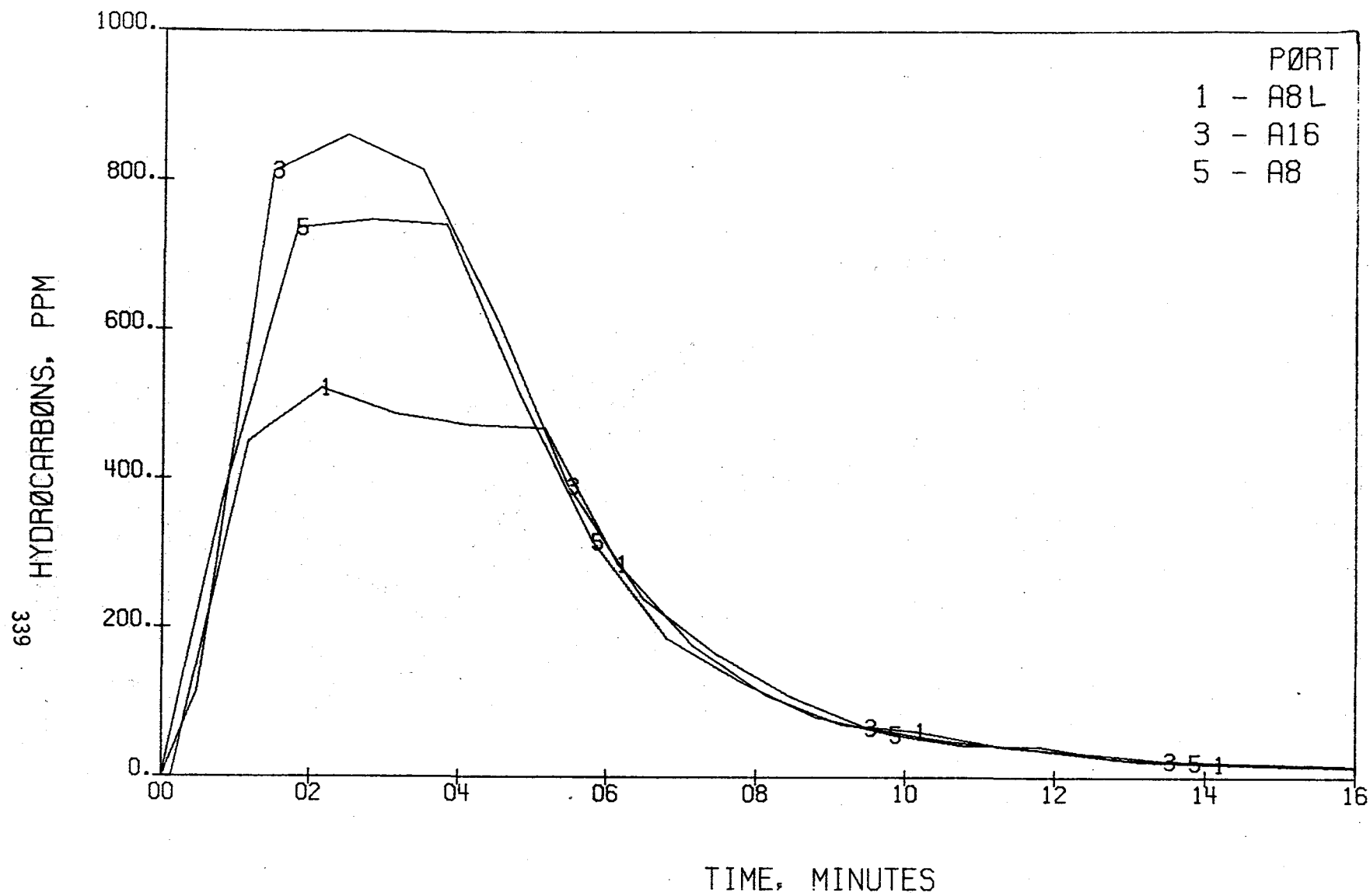


FIGURE 252 . - HYDROCARBONS CONCENTRATIONS , AFT  
TEST 14

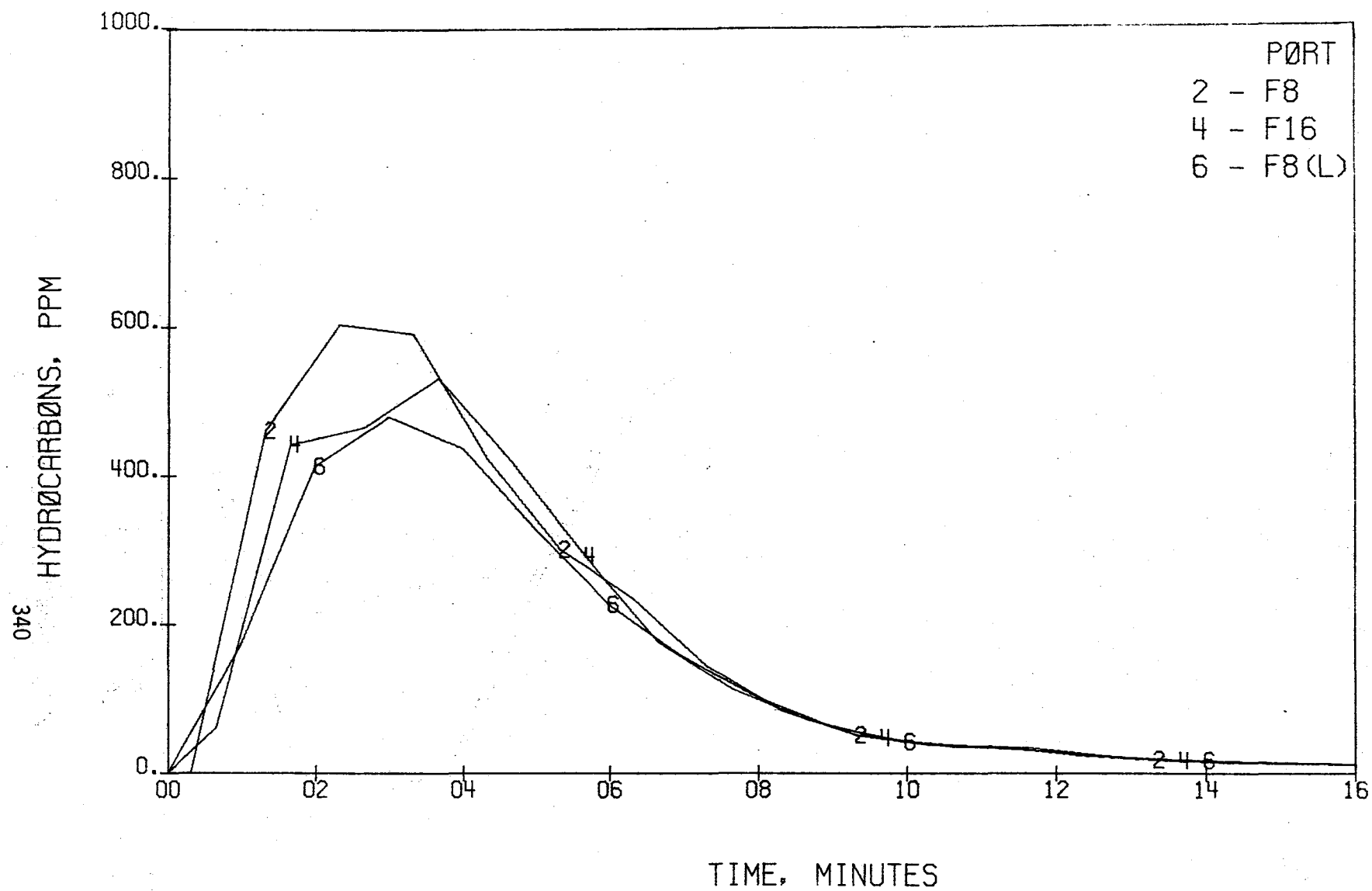


FIGURE 253 . - HYDRØCARBØNS CØNCENTRATIONS , FØRE  
TEST 14

TEST 15

---

BARE URETHANE FOAM SEATS

TEST 15

BARE URETHANE FOAM SEATS

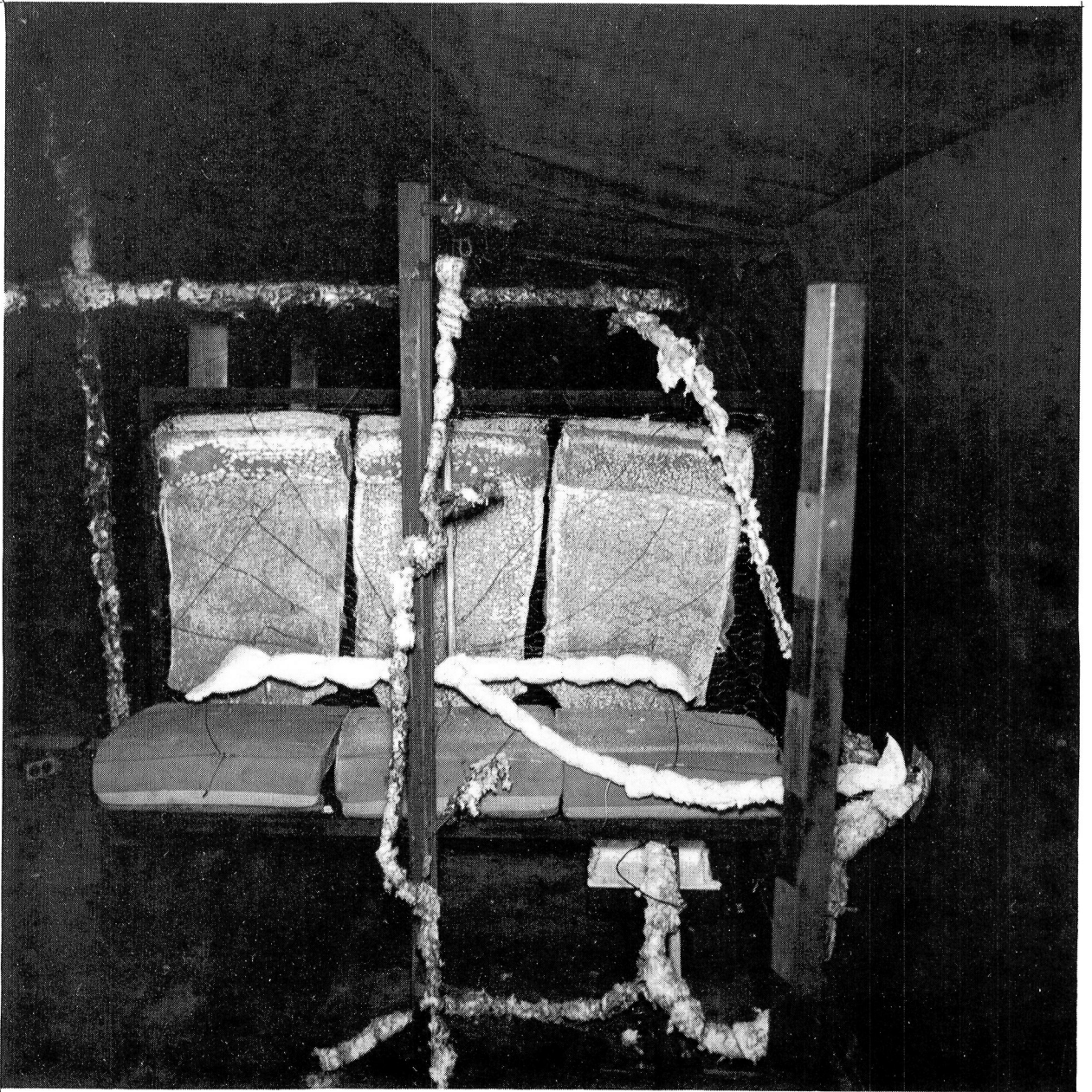


FIGURE 254 . - PRE-TEST CONFIGURATION, TEST 15



FIGURE 255 . - POST-TEST CONFIGURATION, TEST 15





FIGURE 256 . - FIRE DURING TEST 15



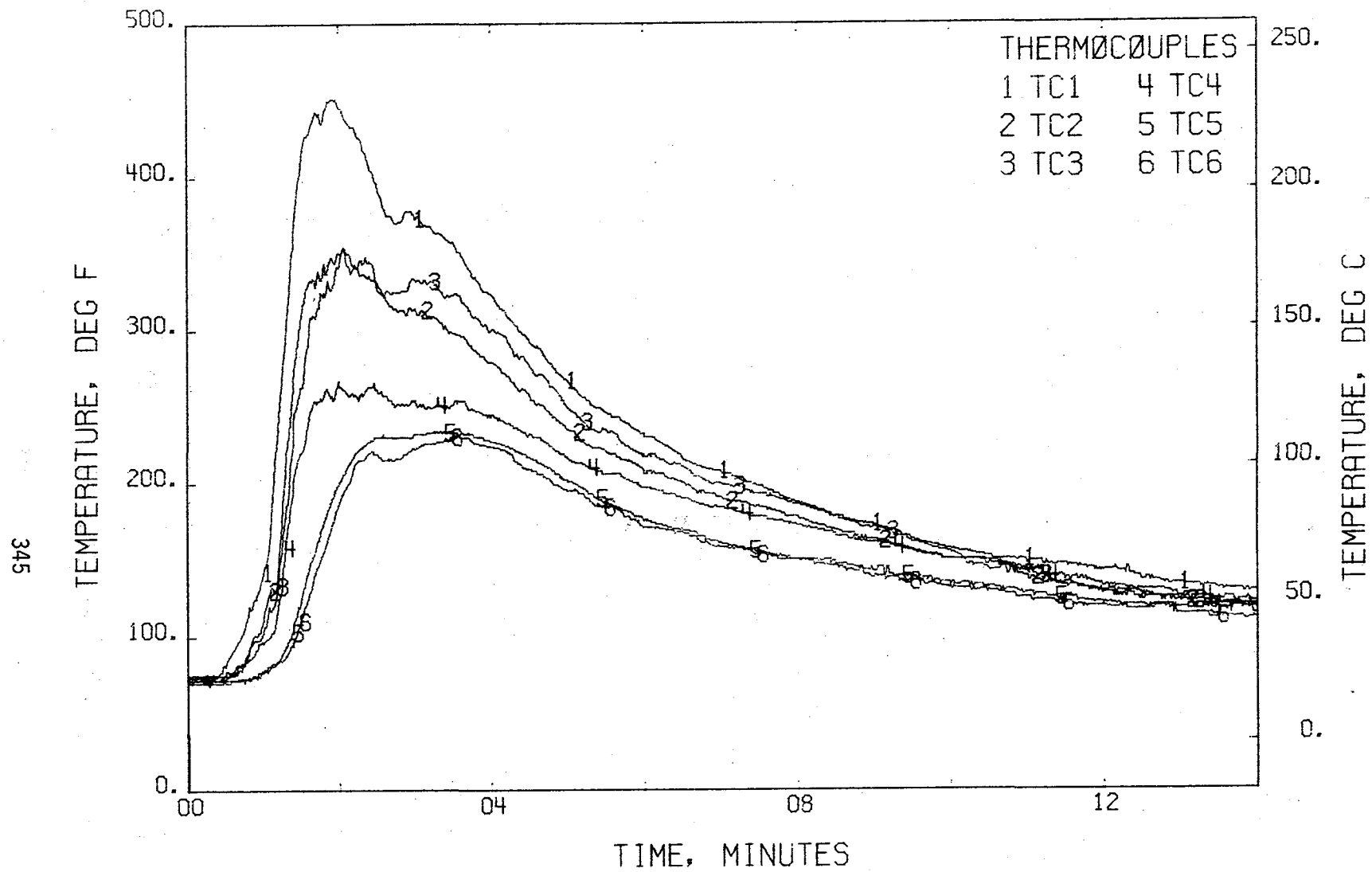
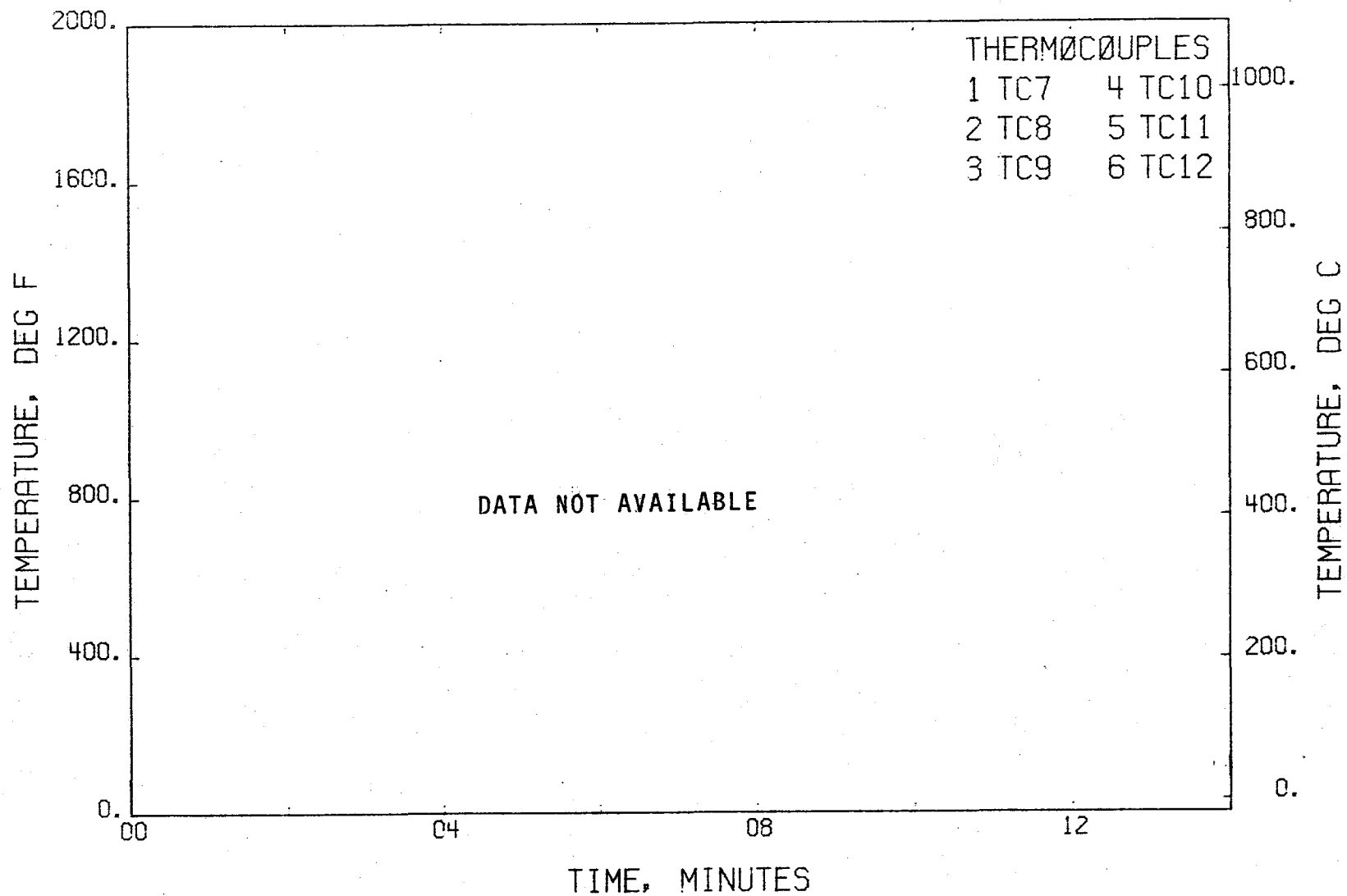


FIGURE 257 . - TEMPERATURES, T/C TREE 1  
TEST 15

346



TEMPERATURES: T/C TREE 2  
TEST 15

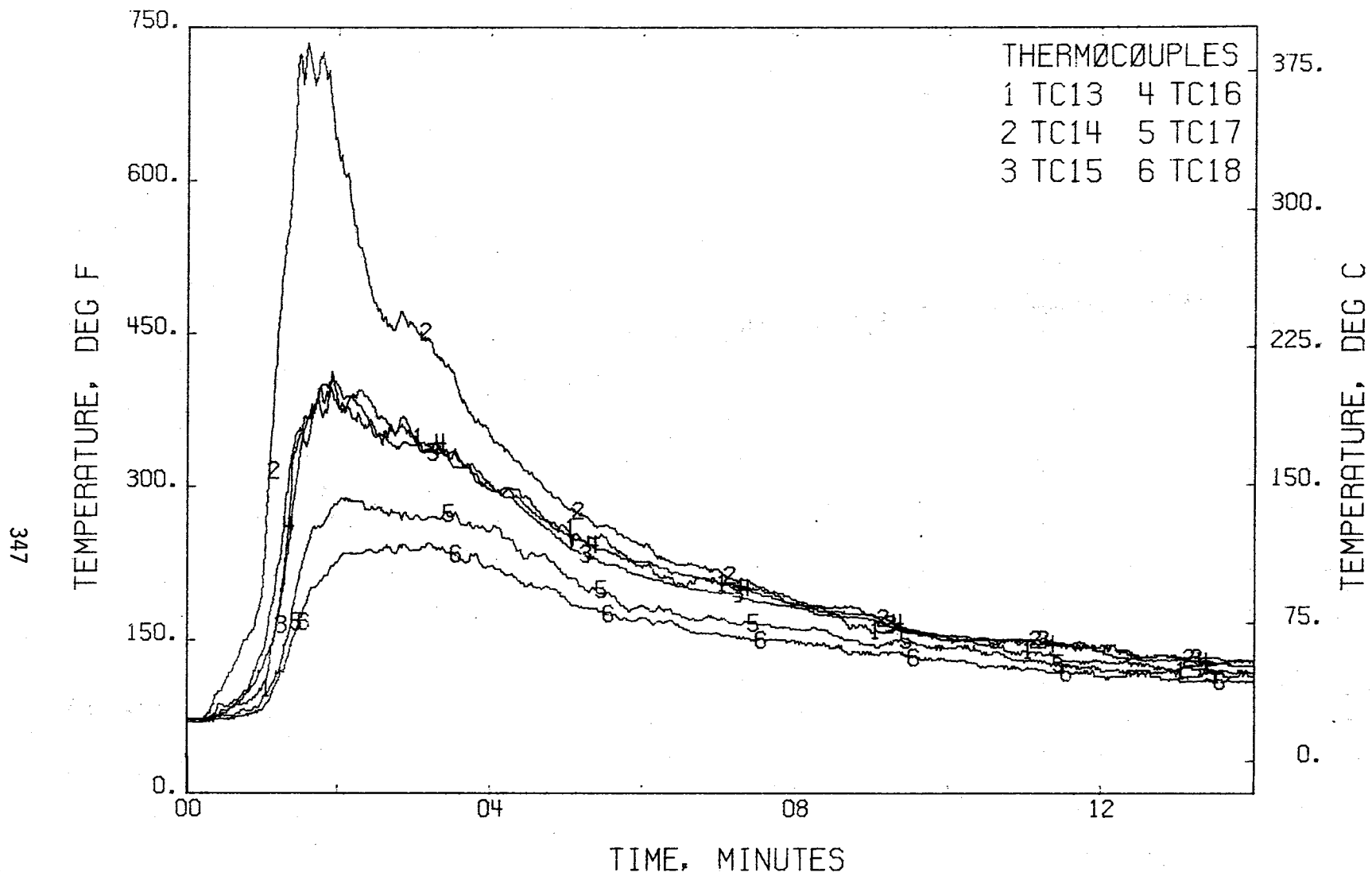


FIGURE 258 . - TEMPERATURES, T/C TREE 3  
TEST 15

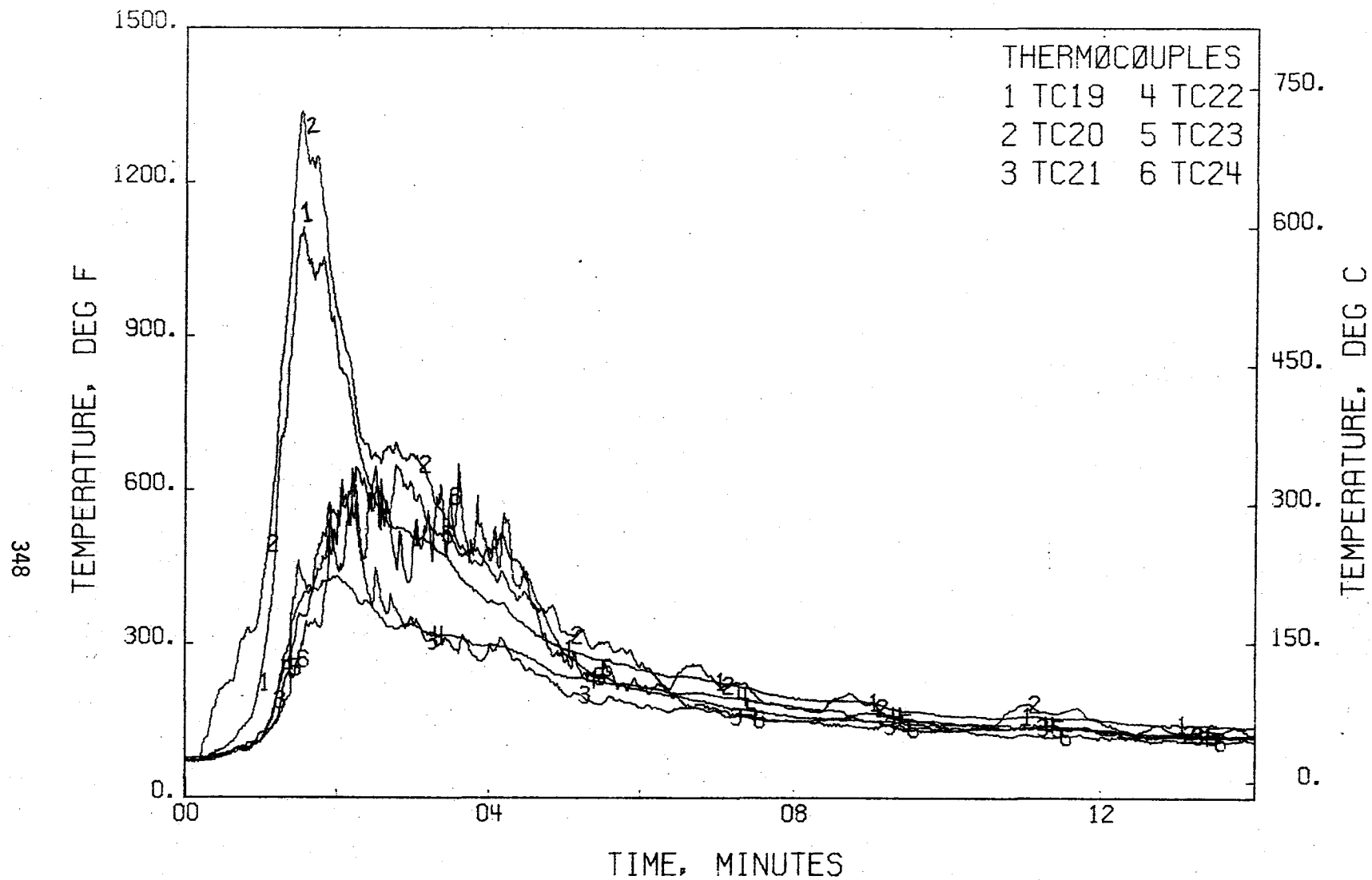


FIGURE 259 . - TEMPERATURES, T/C TREE 4  
TEST 15

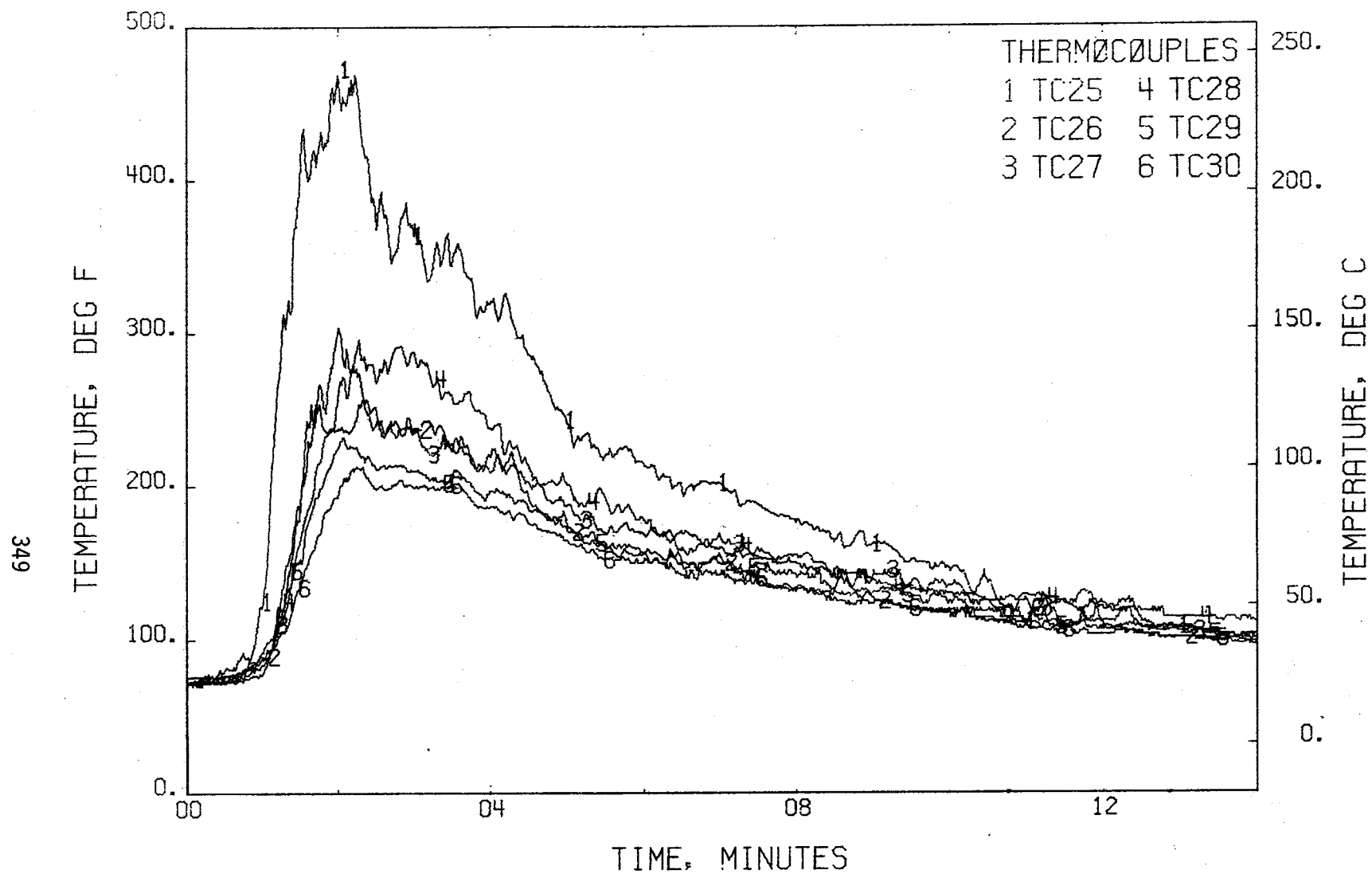


FIGURE 260 . - TEMPERATURES, T/C TREE 5  
TEST 15

350

TEMPERATURE, DEG F

2000.  
1600.  
1200.  
800.  
400.  
0.

00

04

08

12

TIME, MINUTES

THERMOCOUPLES

1 TC31 4 TC34

2 TC32 5 TC35

3 TC33 6 TC36

1000.

800.

600.

400.

200.

0.

TEMPERATURE, DEG C

DATA NOT AVAILABLE

TEMPERATURES, T/C TREE 6  
TEST 15

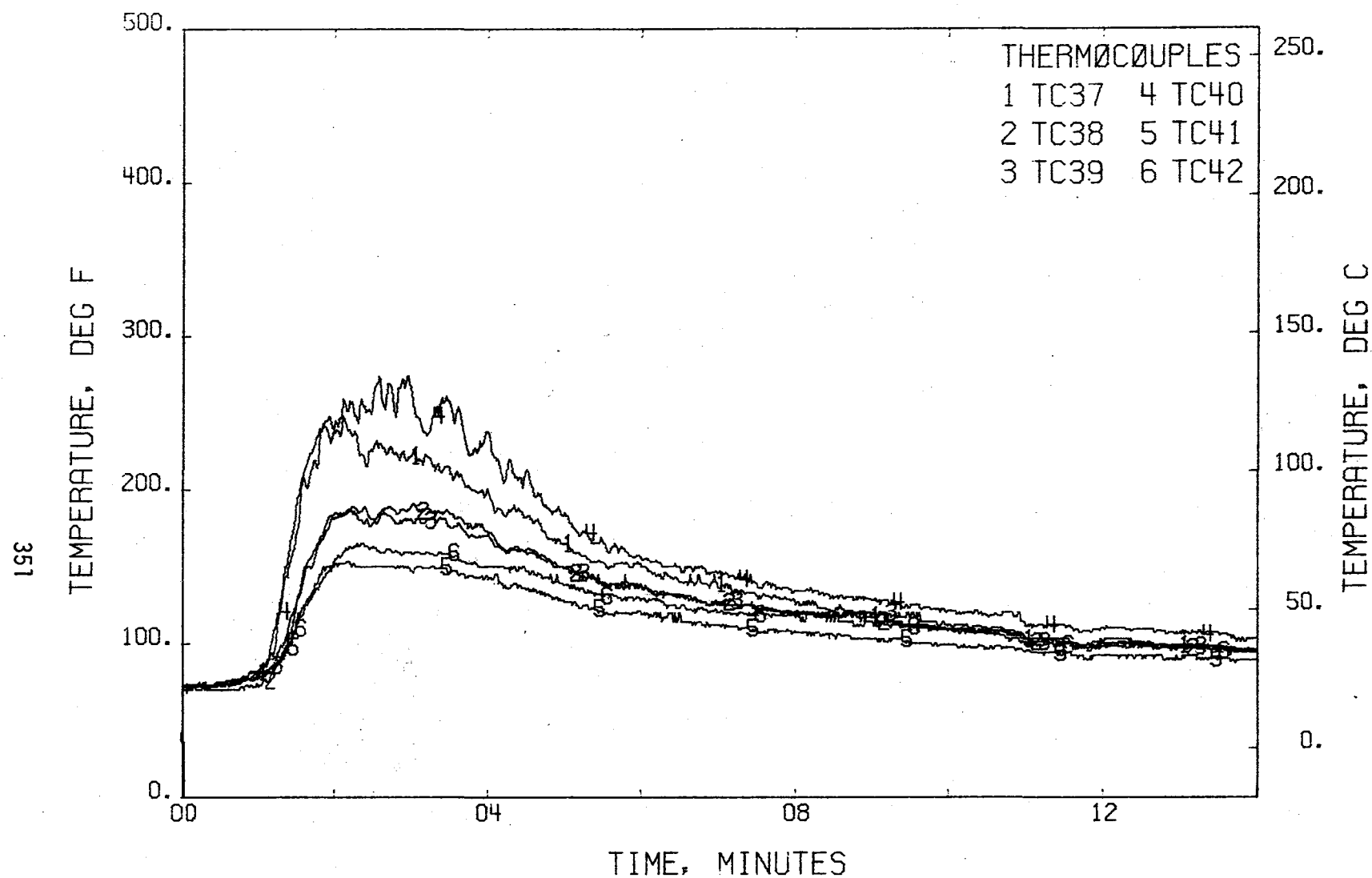


FIGURE 261 . - TEMPERATURES, T/C TREE 7  
TEST 15

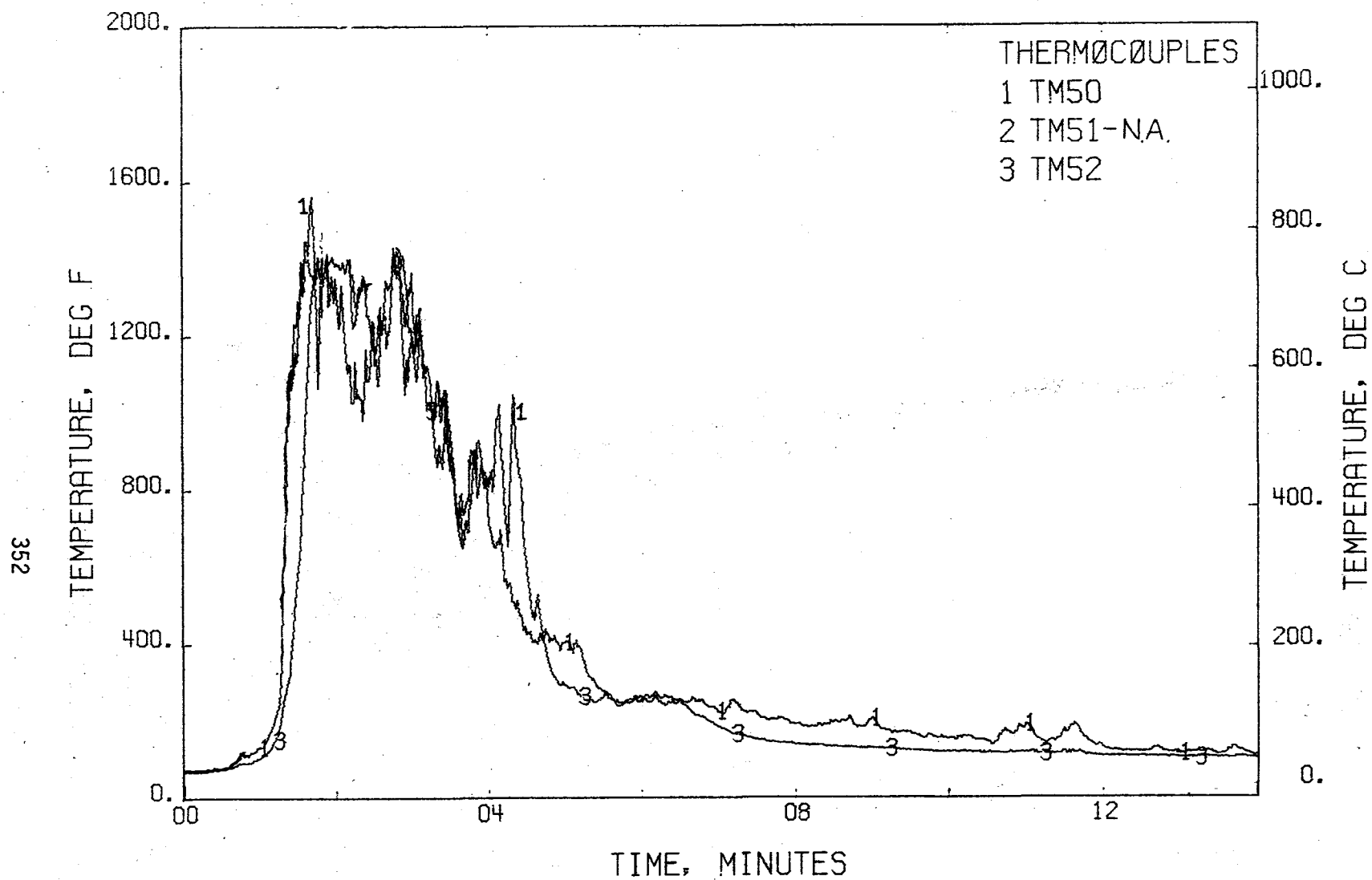


FIGURE 262 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 15



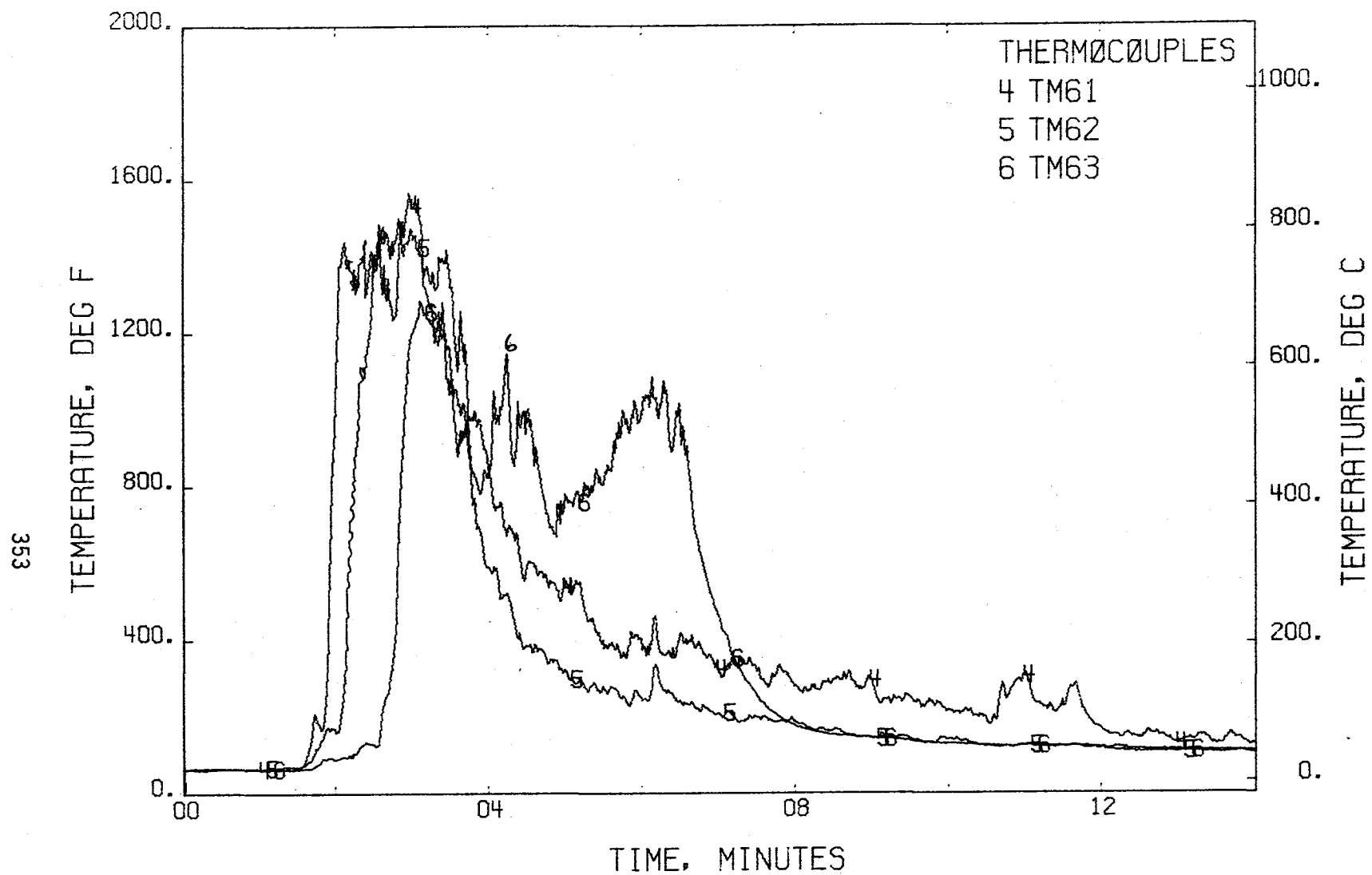


FIGURE 262 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)-CONT.  
TEST 15

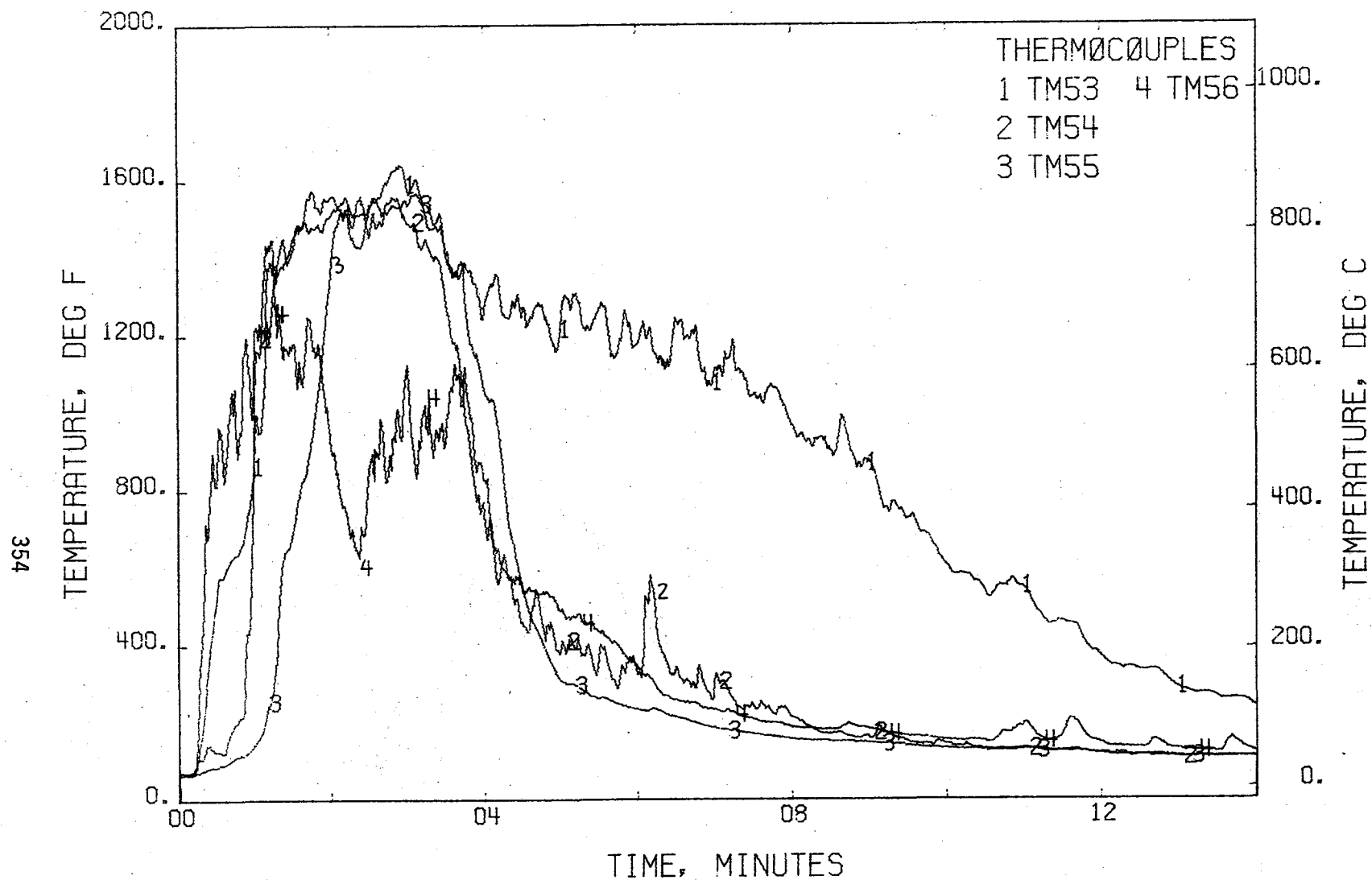


FIGURE 263 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 15

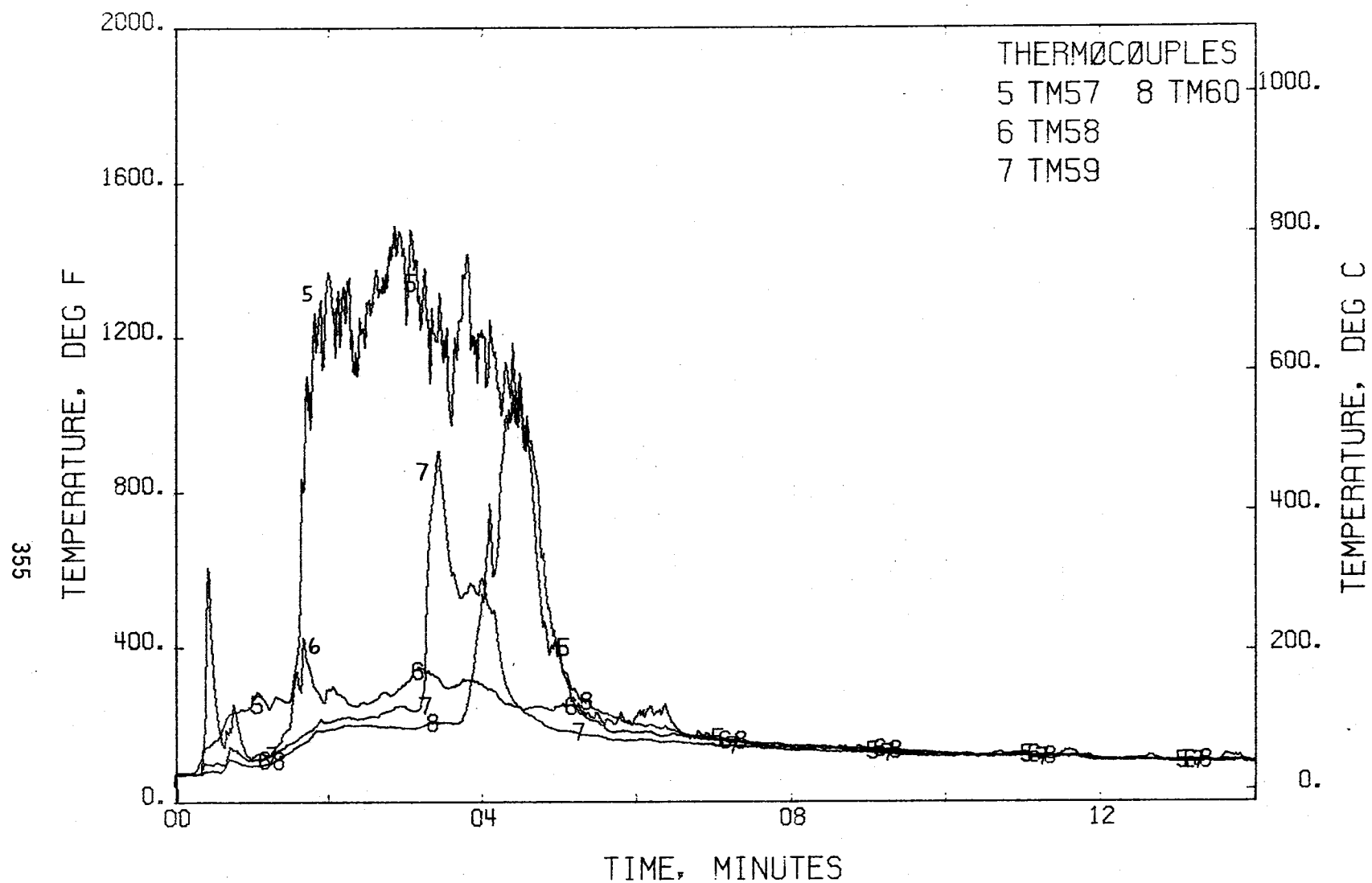


FIGURE 263 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 15

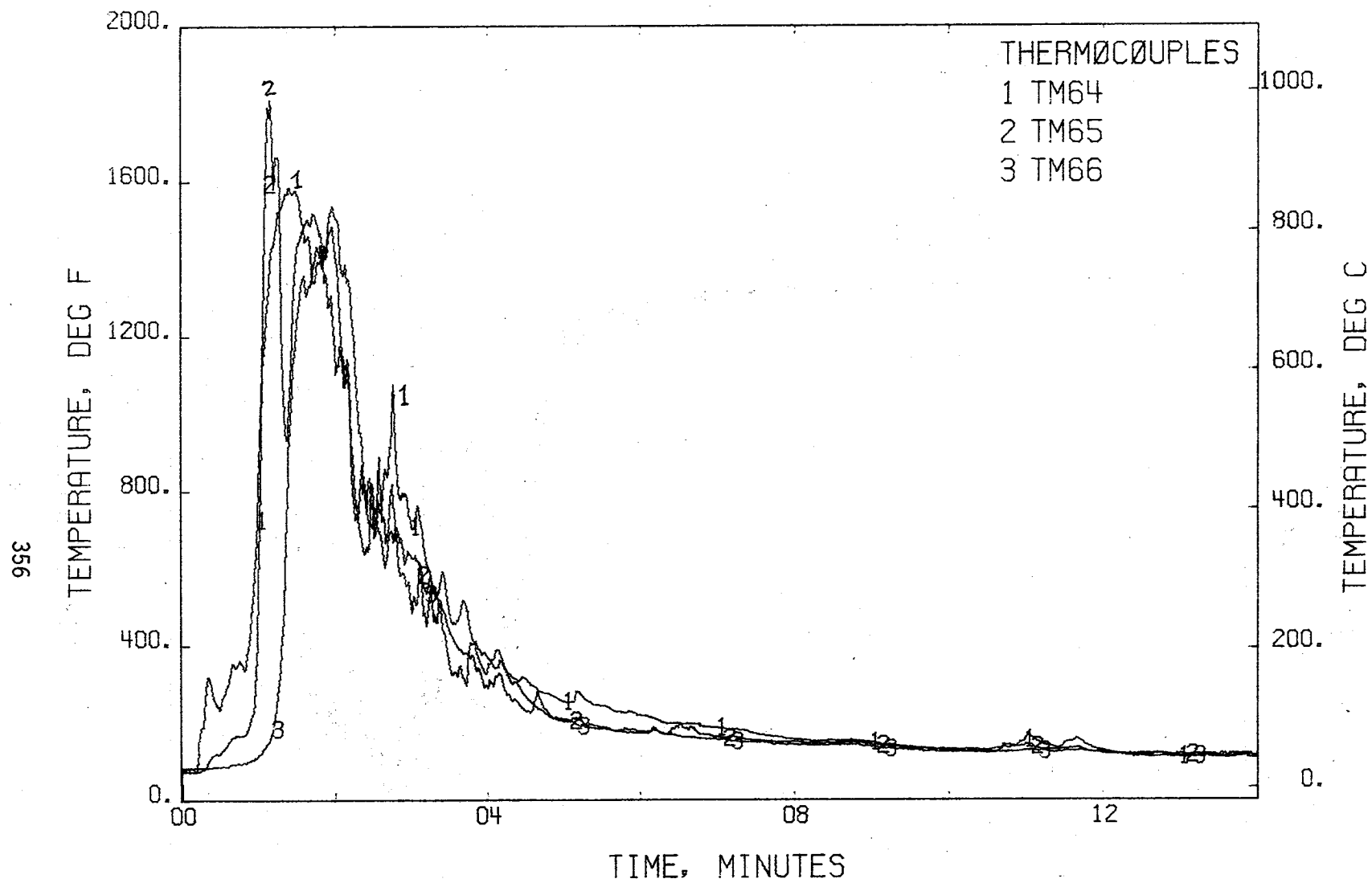


FIGURE 264 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 15

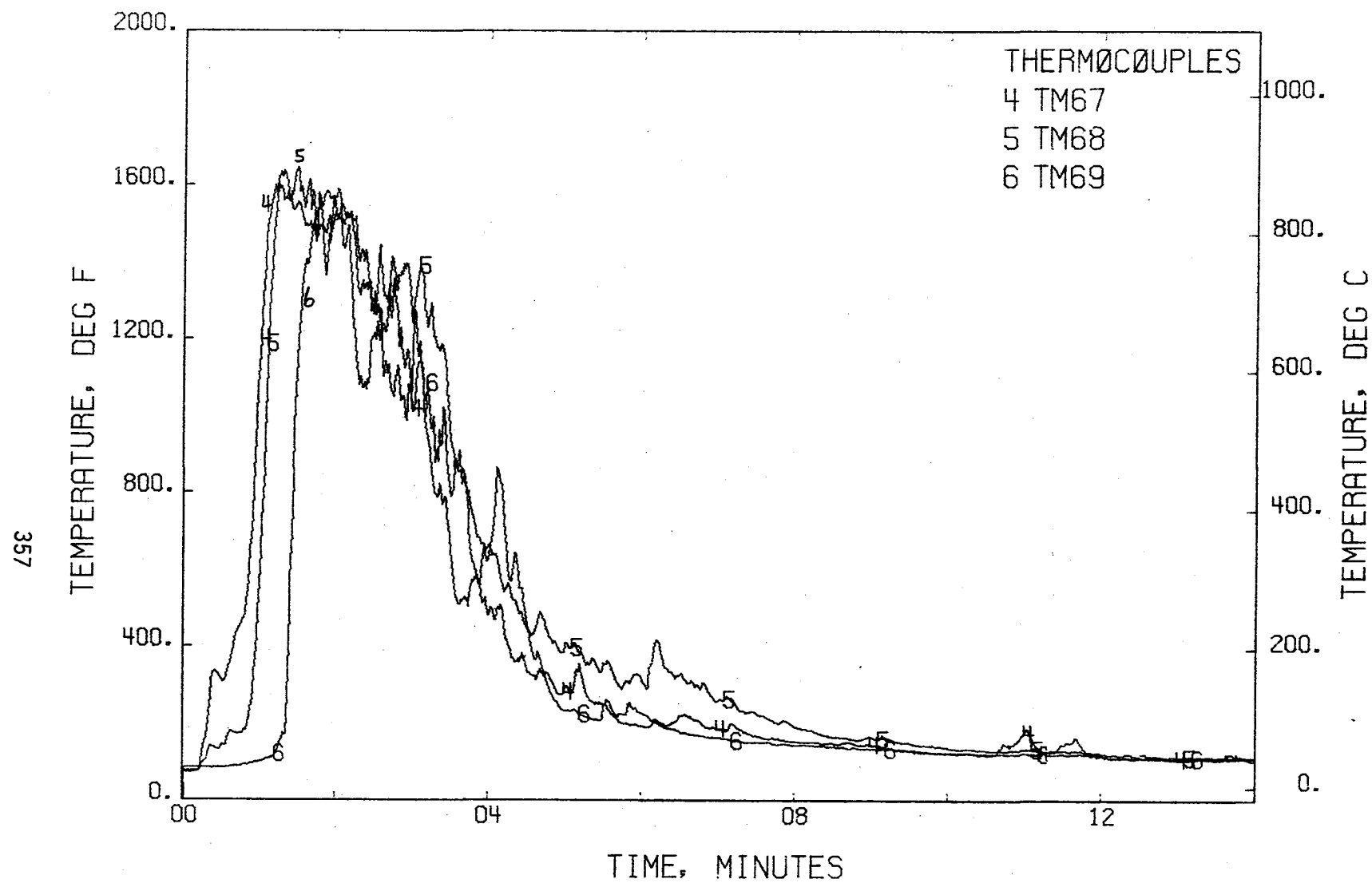


FIGURE 264 . - TEMPERATURES, SEAT BACKS (REAR)-CONT.  
TEST 15

358

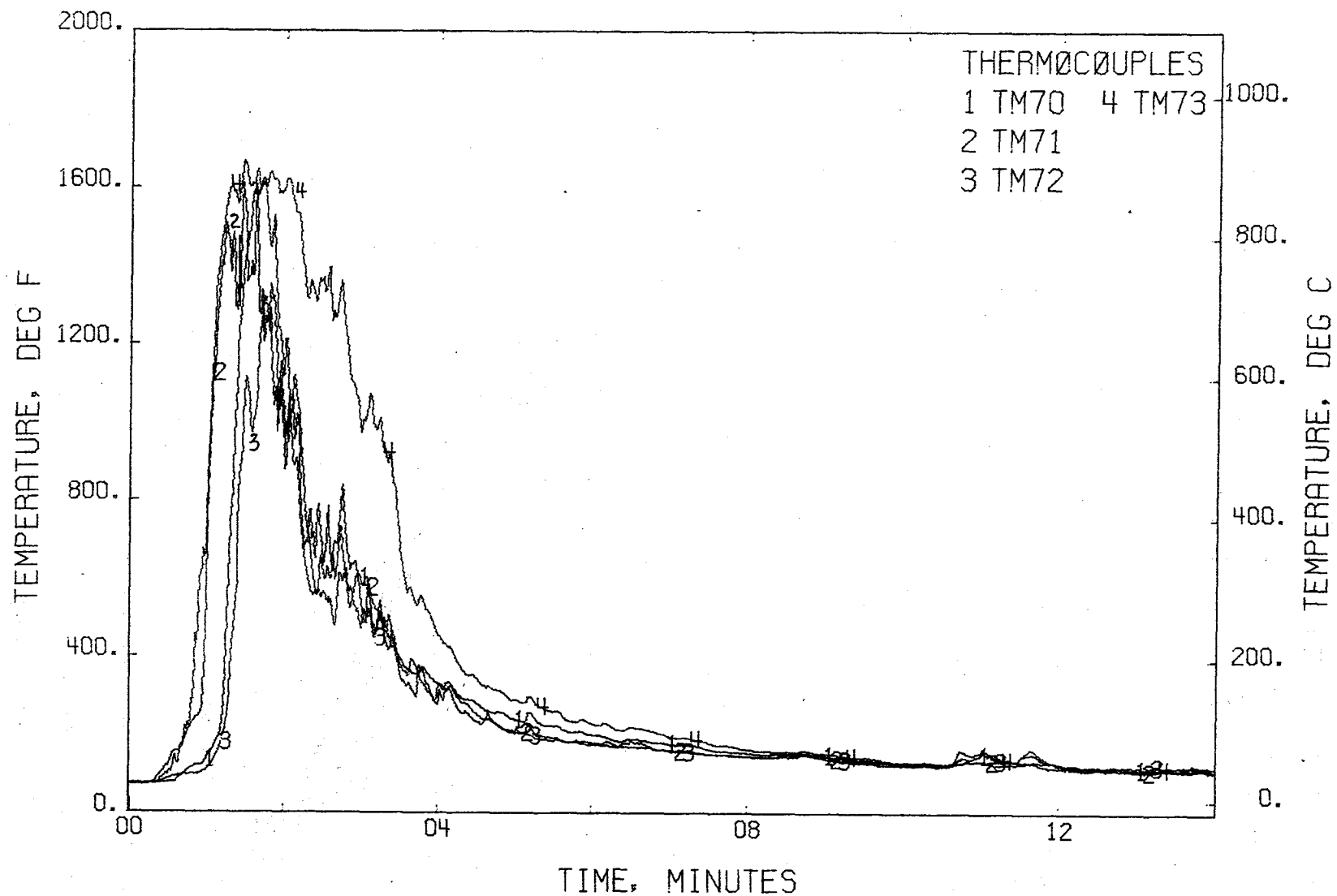


FIGURE 265 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 15

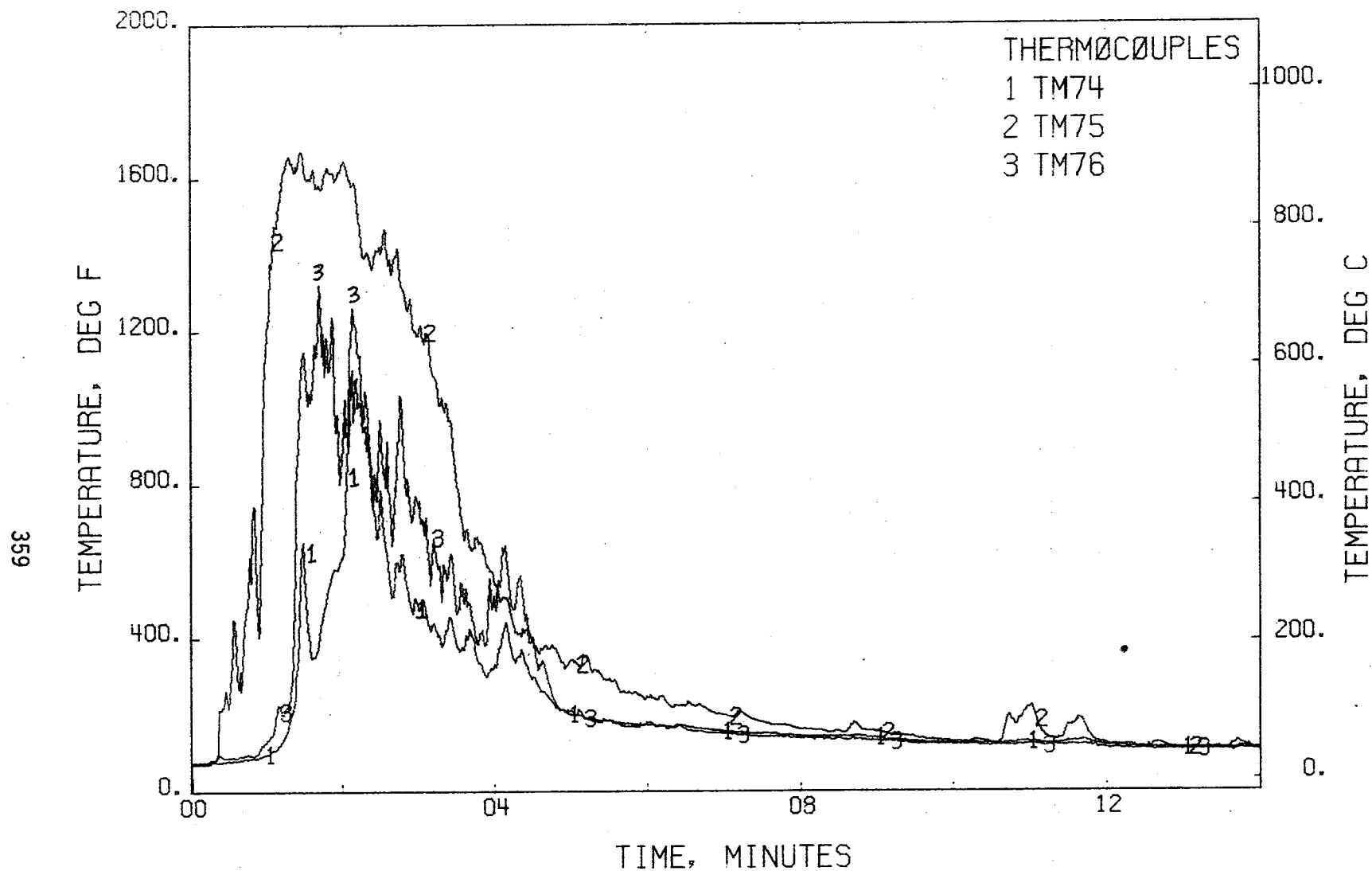


FIGURE 265 . - TEMPERATURES, SEAT BACKS (EDGES)-CONT.  
TEST 15

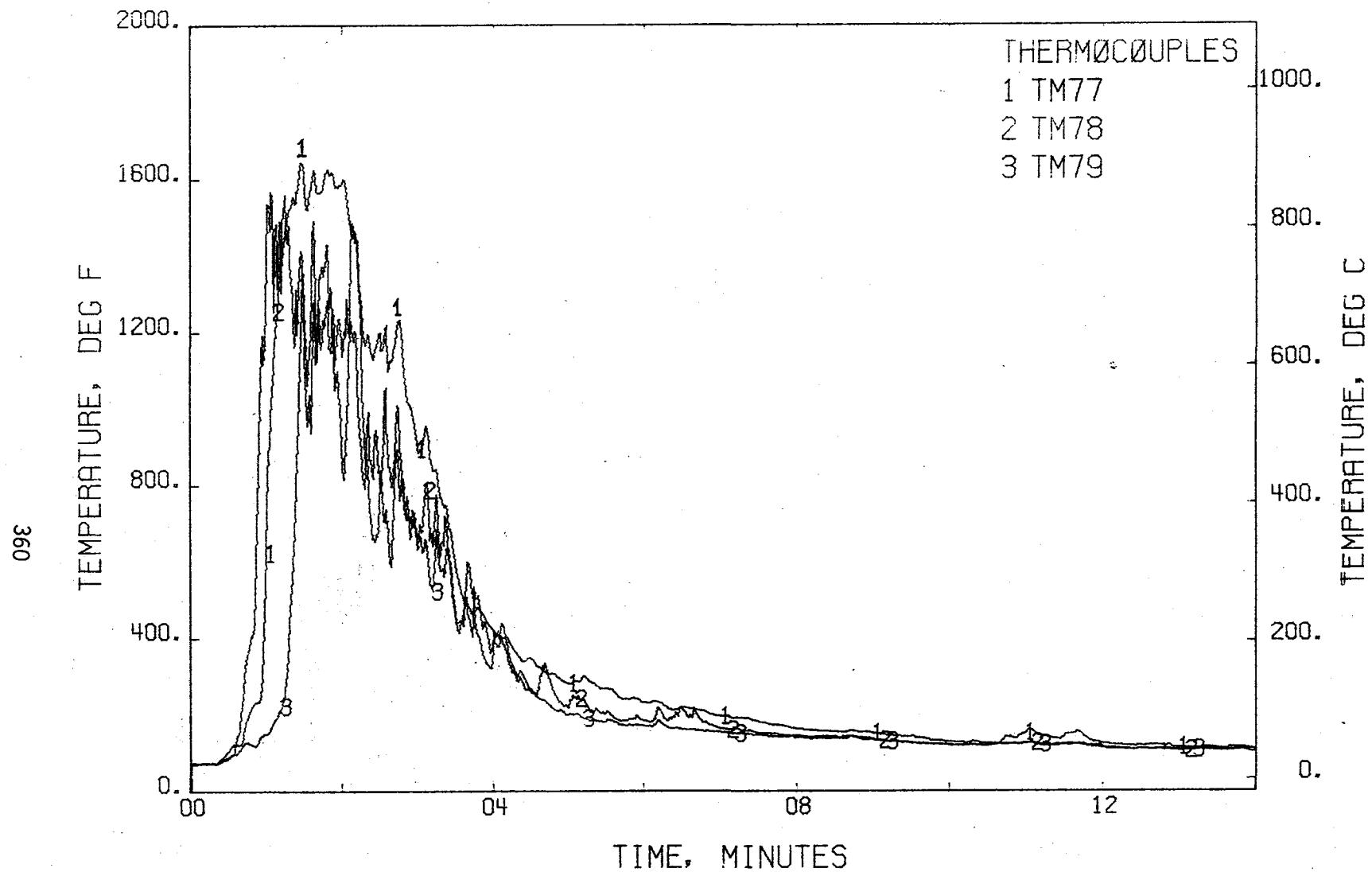


FIGURE 266 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 15



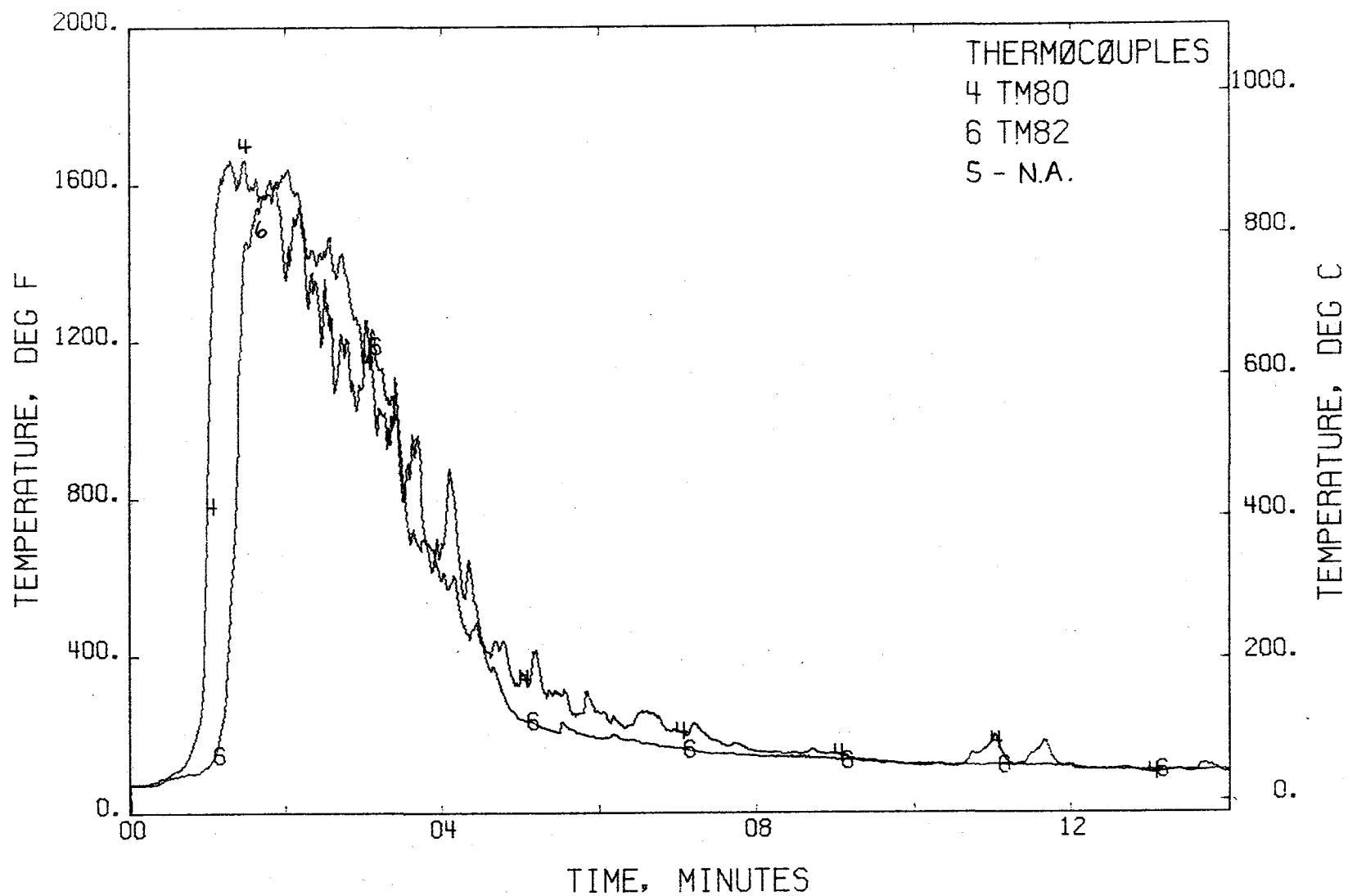


FIGURE 266 . - TEMPERATURES, SEAT BACKS (FRONT)-CONT.  
TEST 15

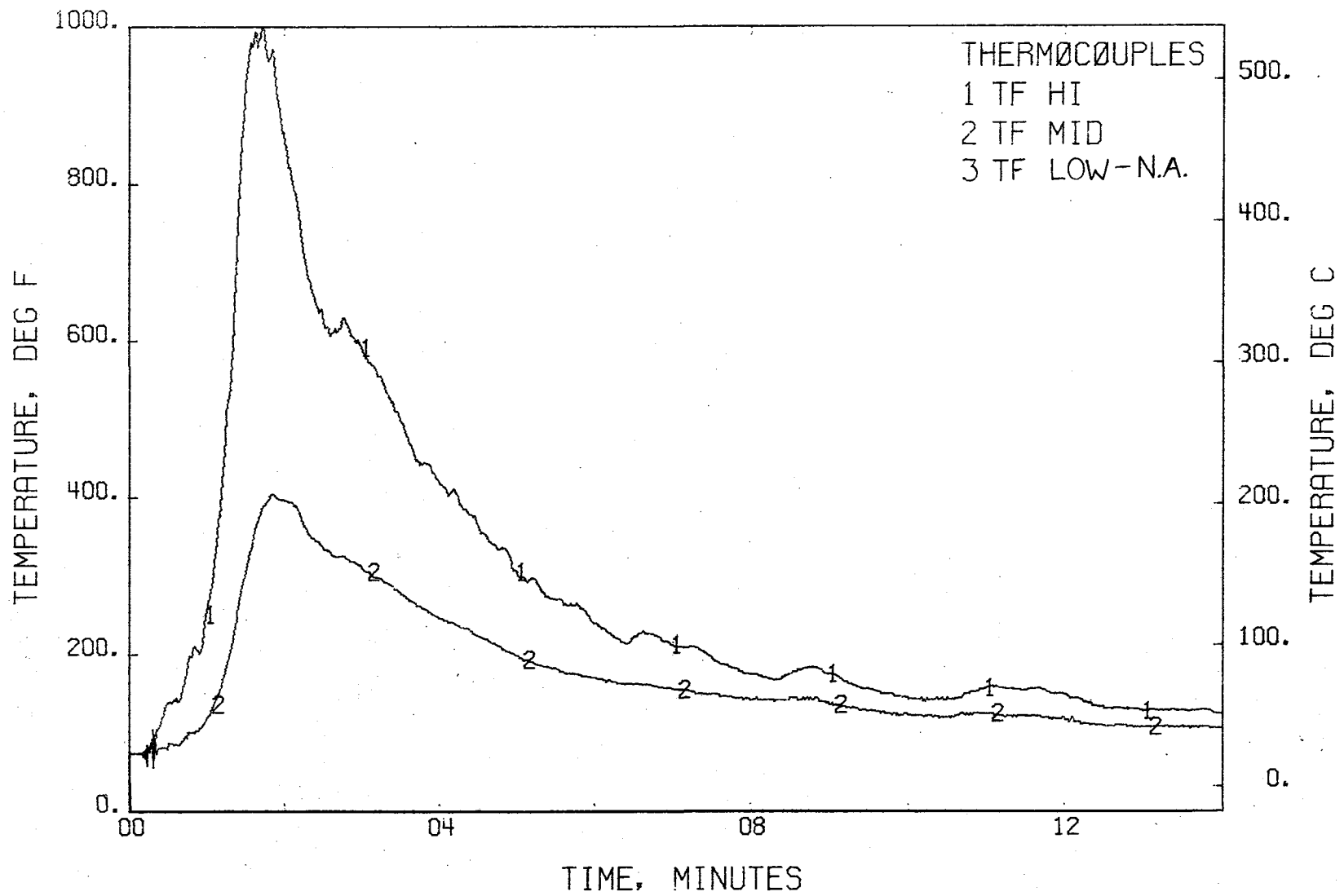


FIGURE 267 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 15

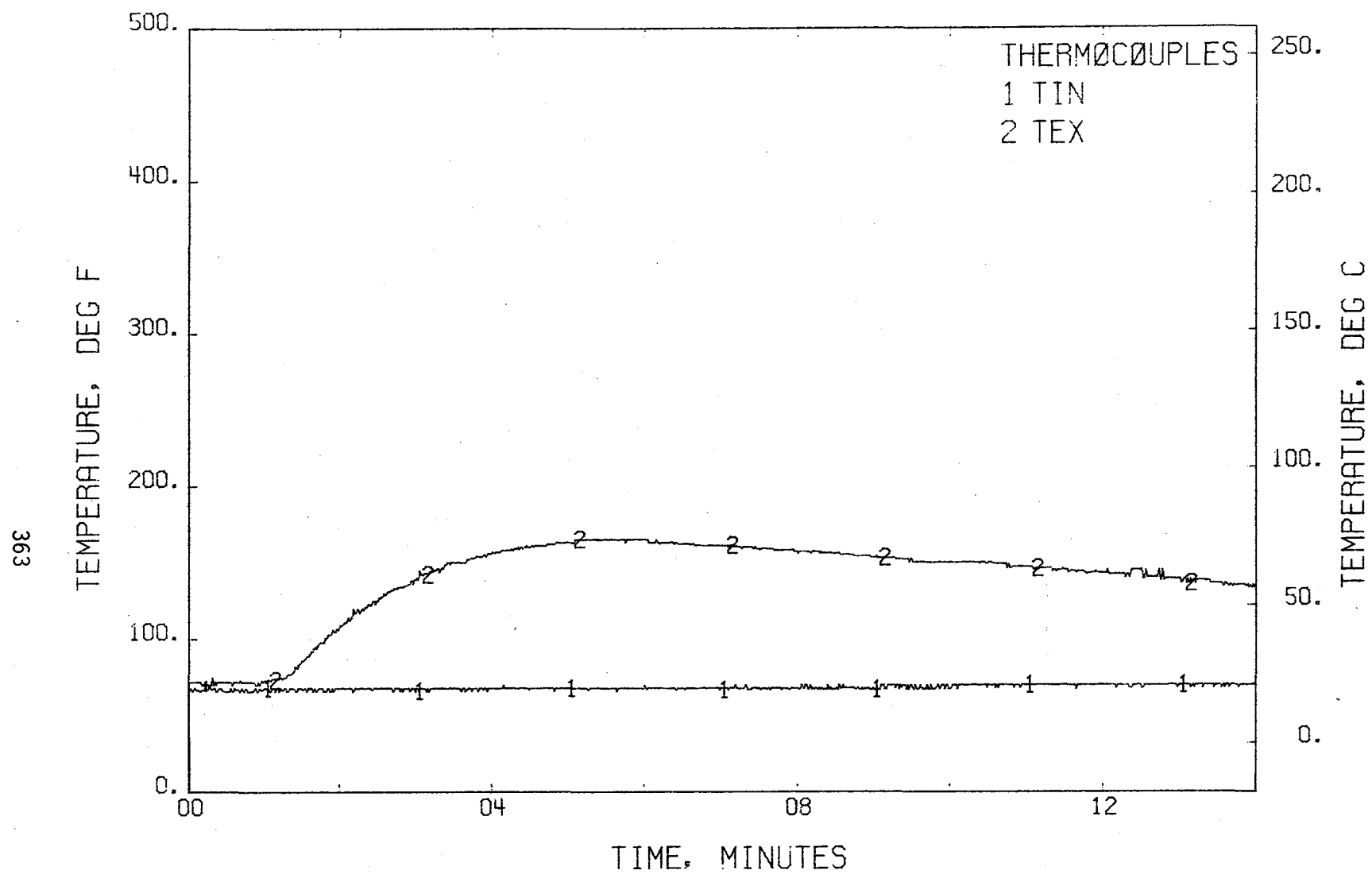


FIGURE 268 . - TEMPERATURES, INLET + EXIT  
TEST 15

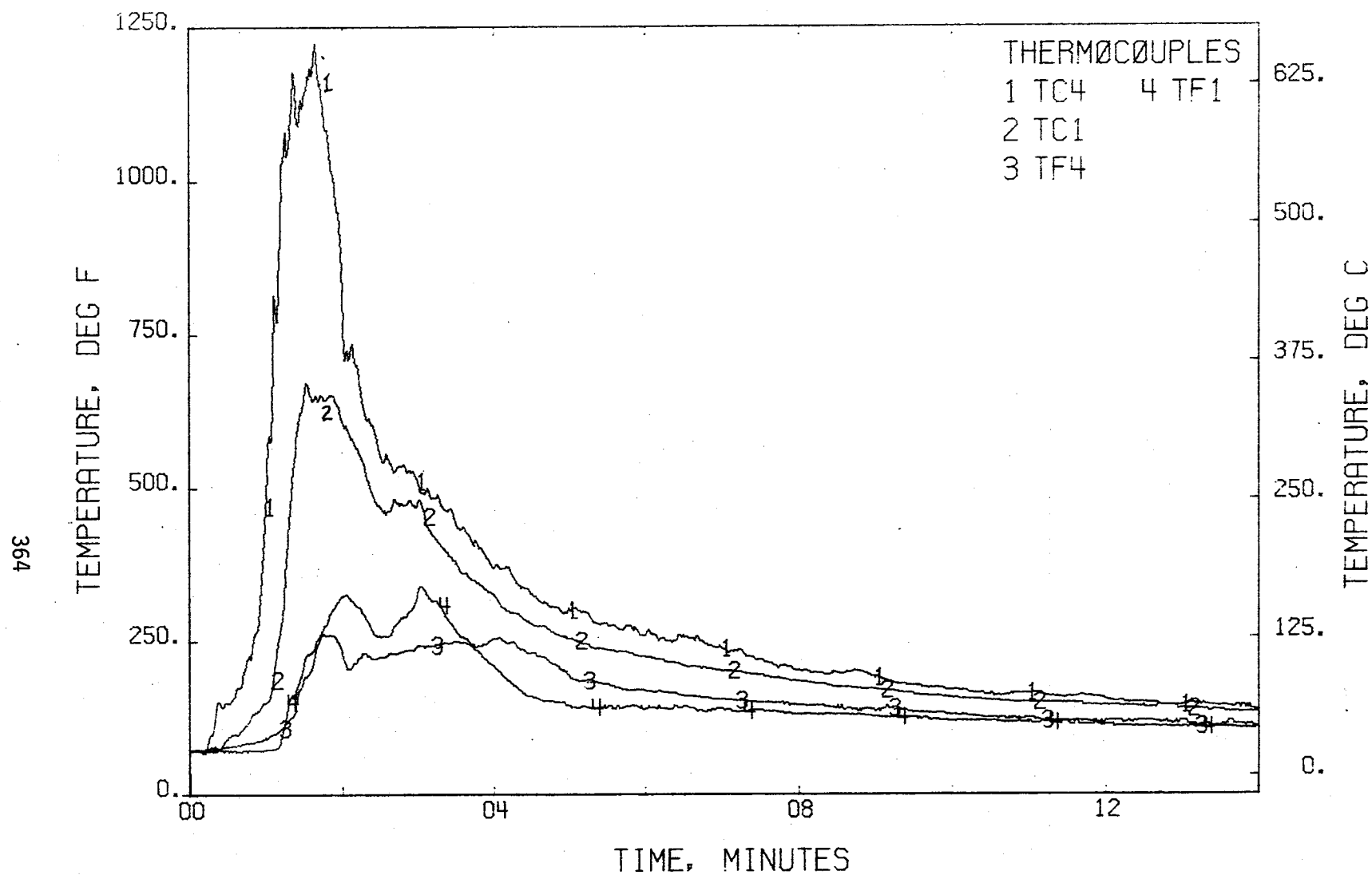


FIGURE 269 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 15

365

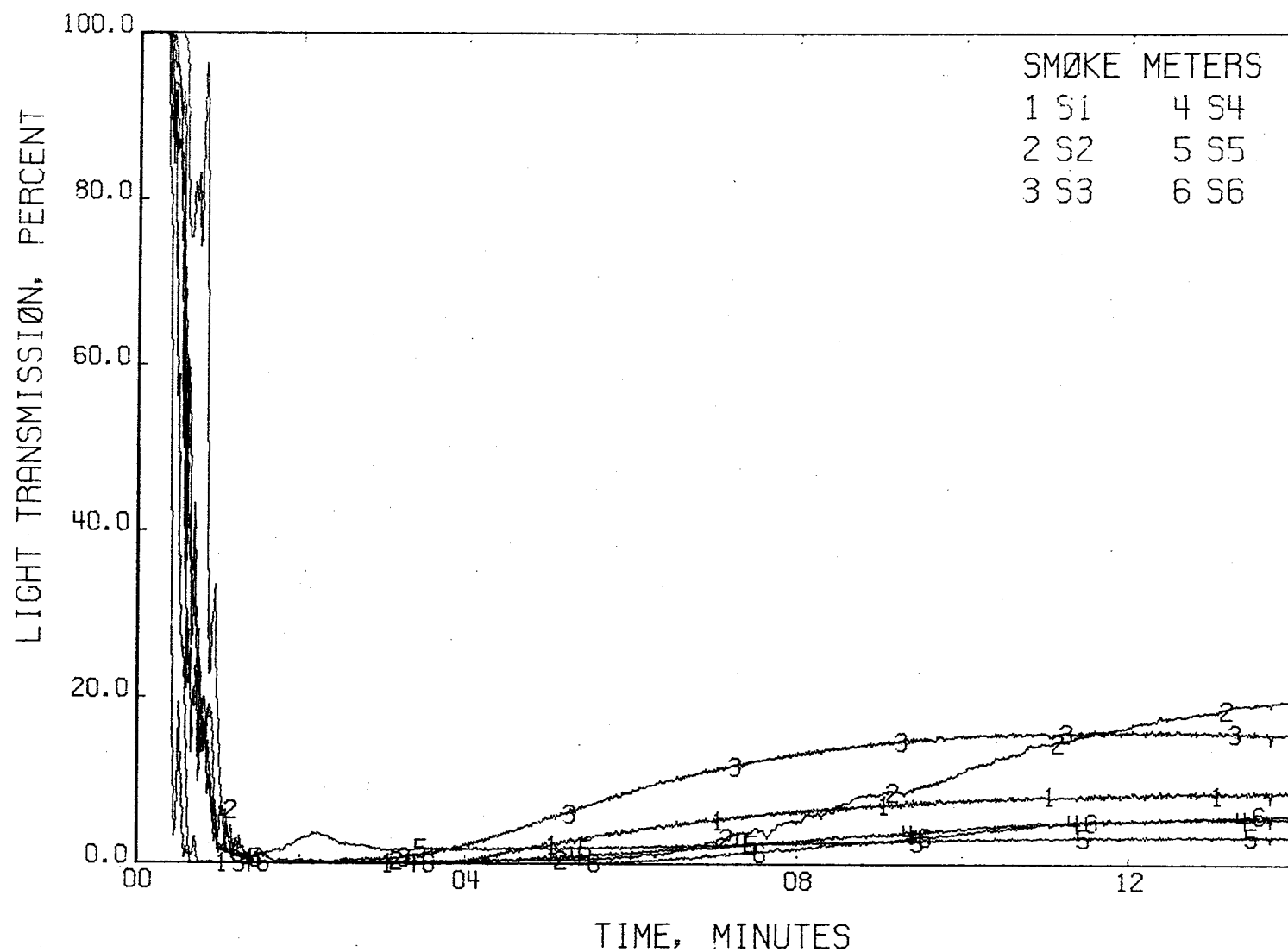


FIGURE 270 . - LIGHT TRANSMISSION  
TEST 15

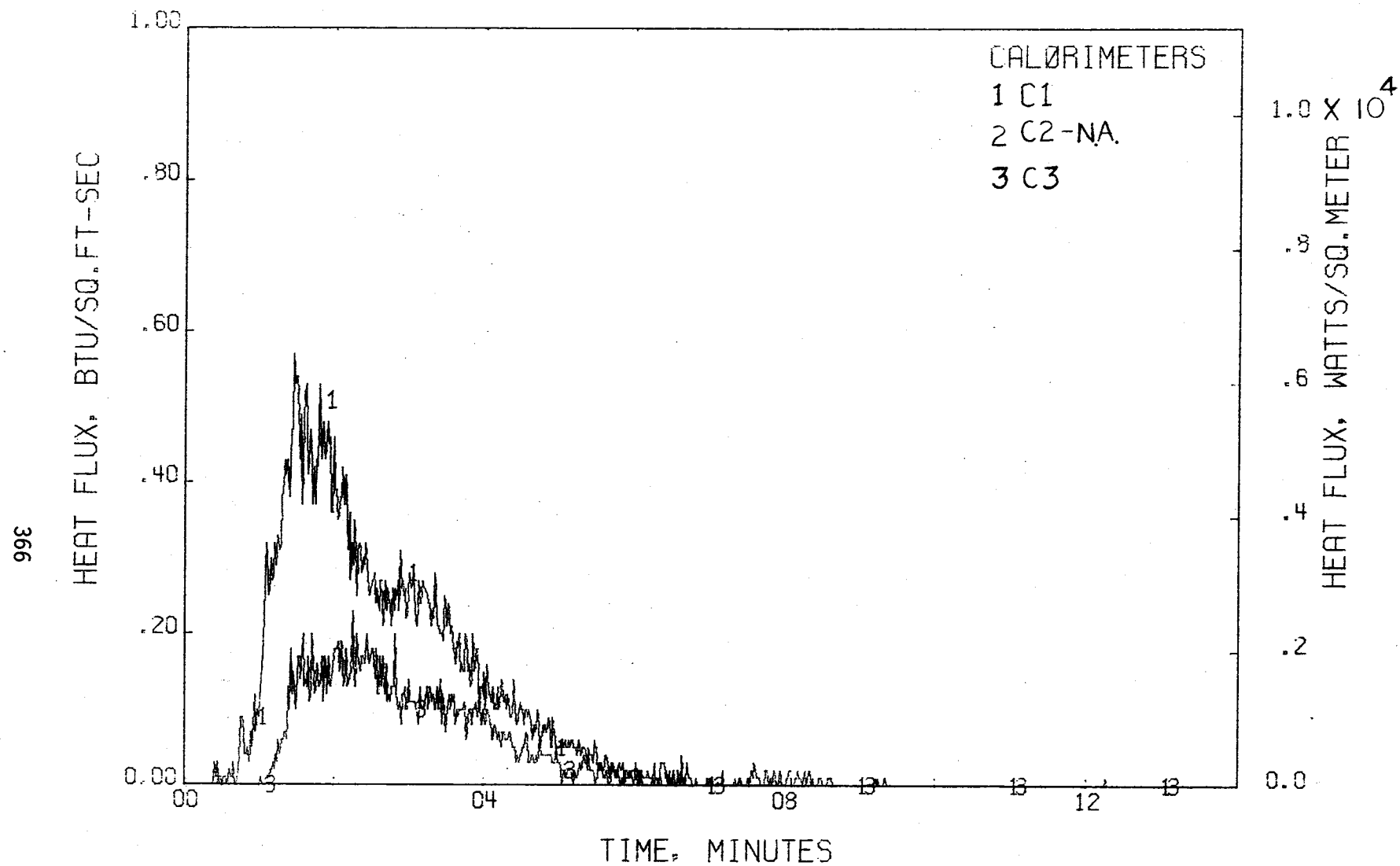


FIGURE 271 . - HEAT FLUX. AFT  
TEST 15

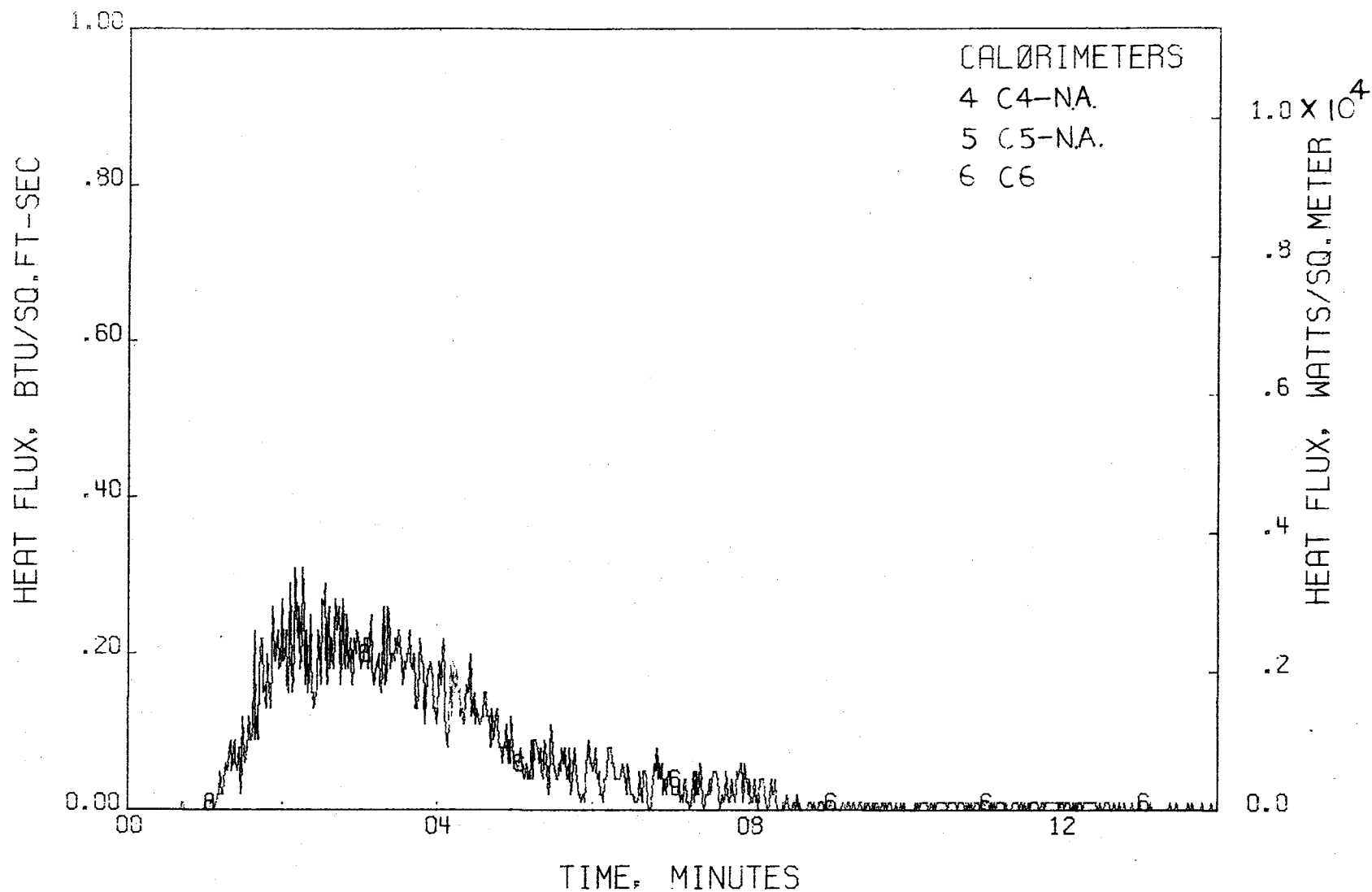


FIGURE 272 . - HEAT FLUX, MIDSECTION  
TEST 15

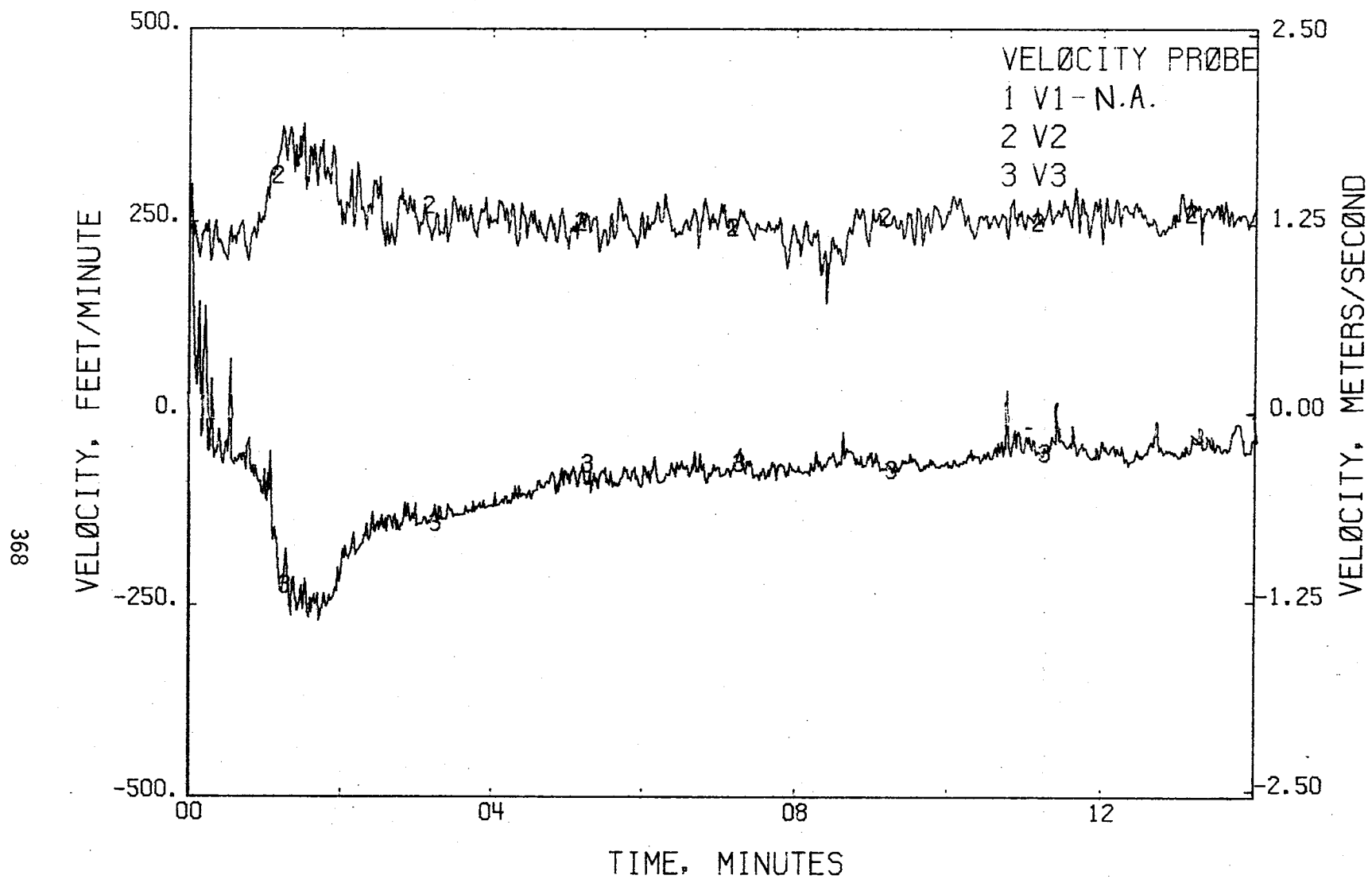


FIGURE 273 . - AIR VELOCITY  
TEST 15



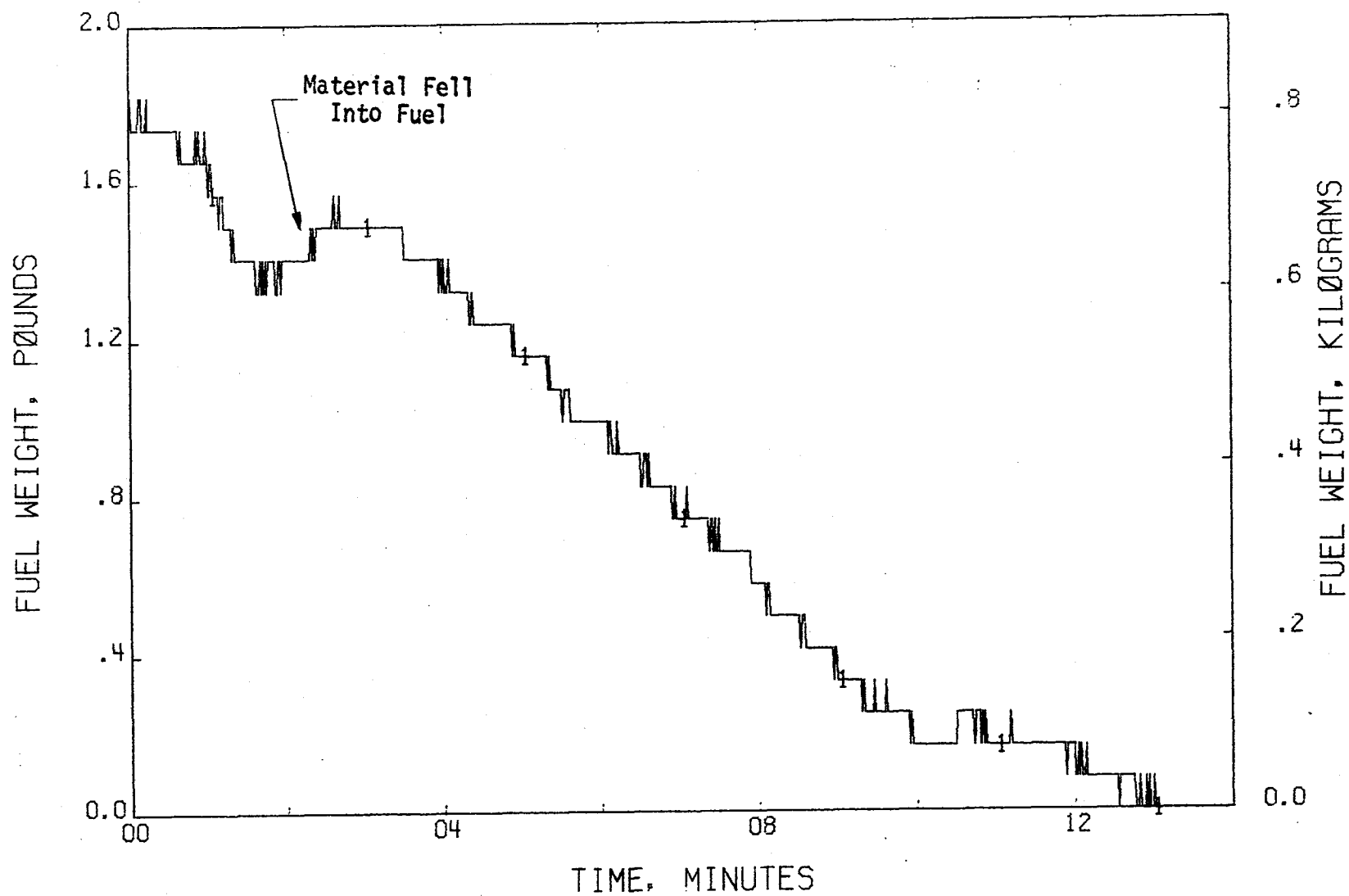


FIGURE 274 . - FUEL WEIGHT LOSS  
TEST 15

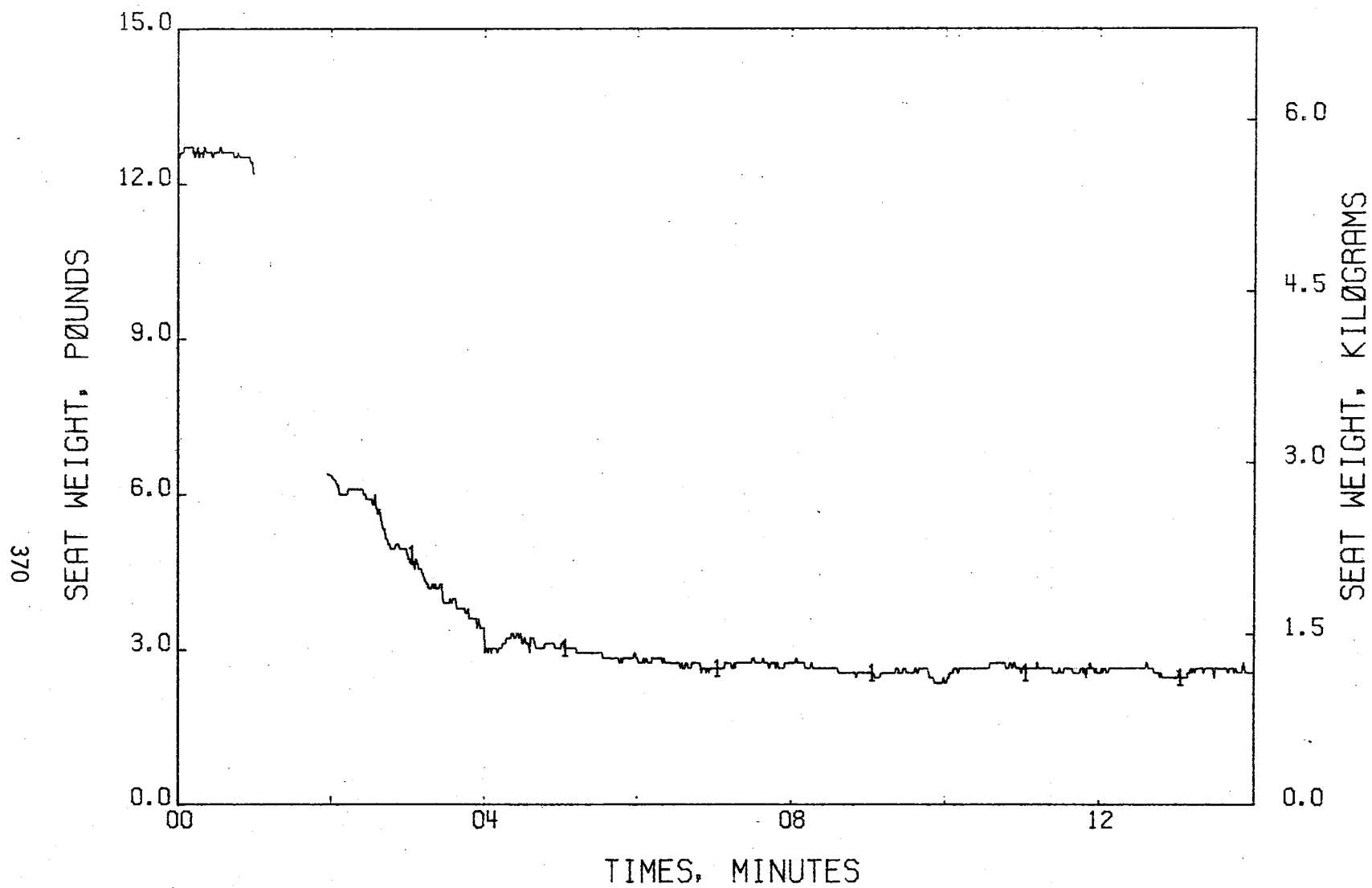


FIGURE 275 . - SEAT WEIGHT LOSS  
TEST 15

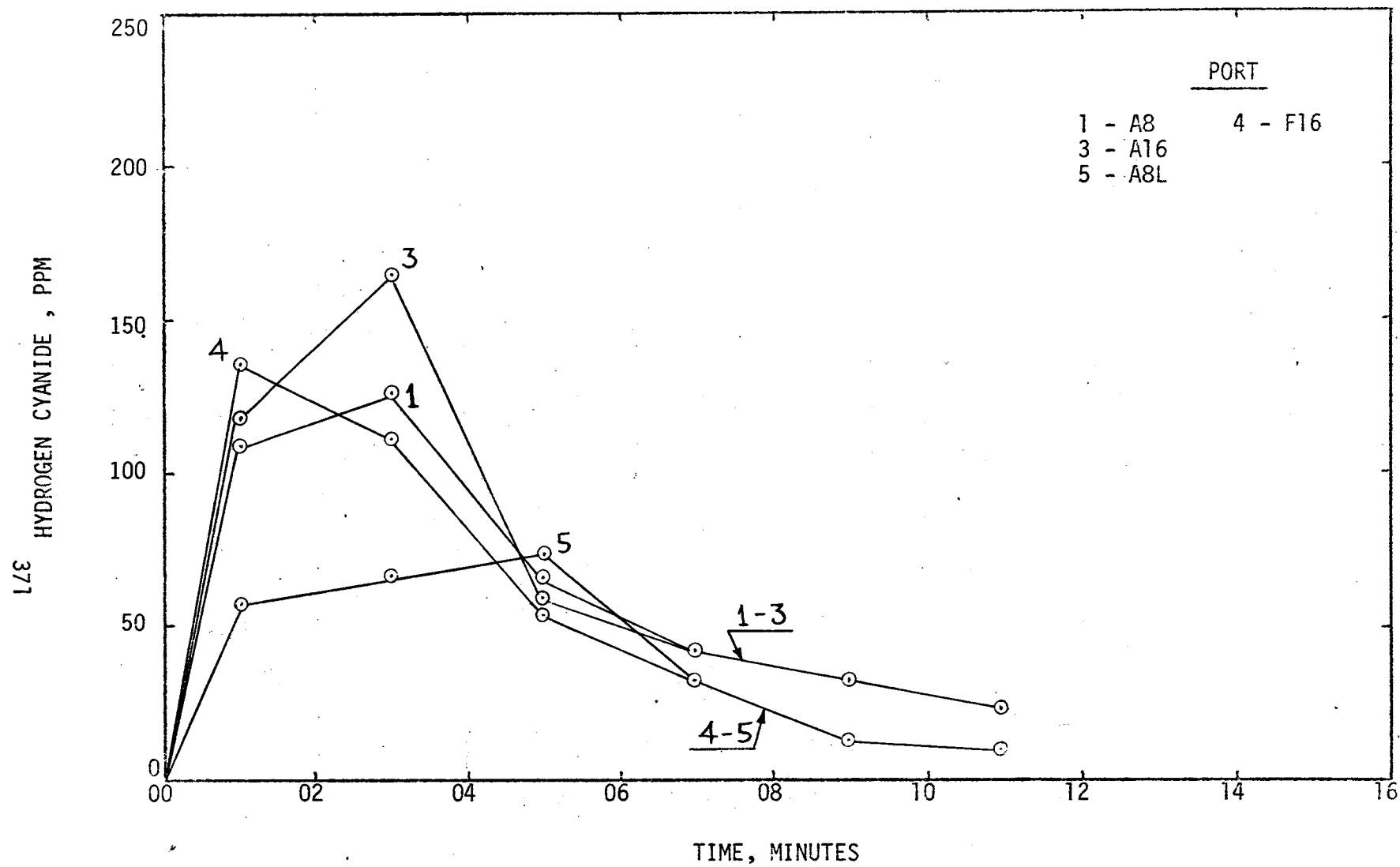


FIGURE 276 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 15

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 3 PPM

372

FIGURE 277 . - HYDROGEN FLUORIDE CONCENTRATIONS  
TEST 15

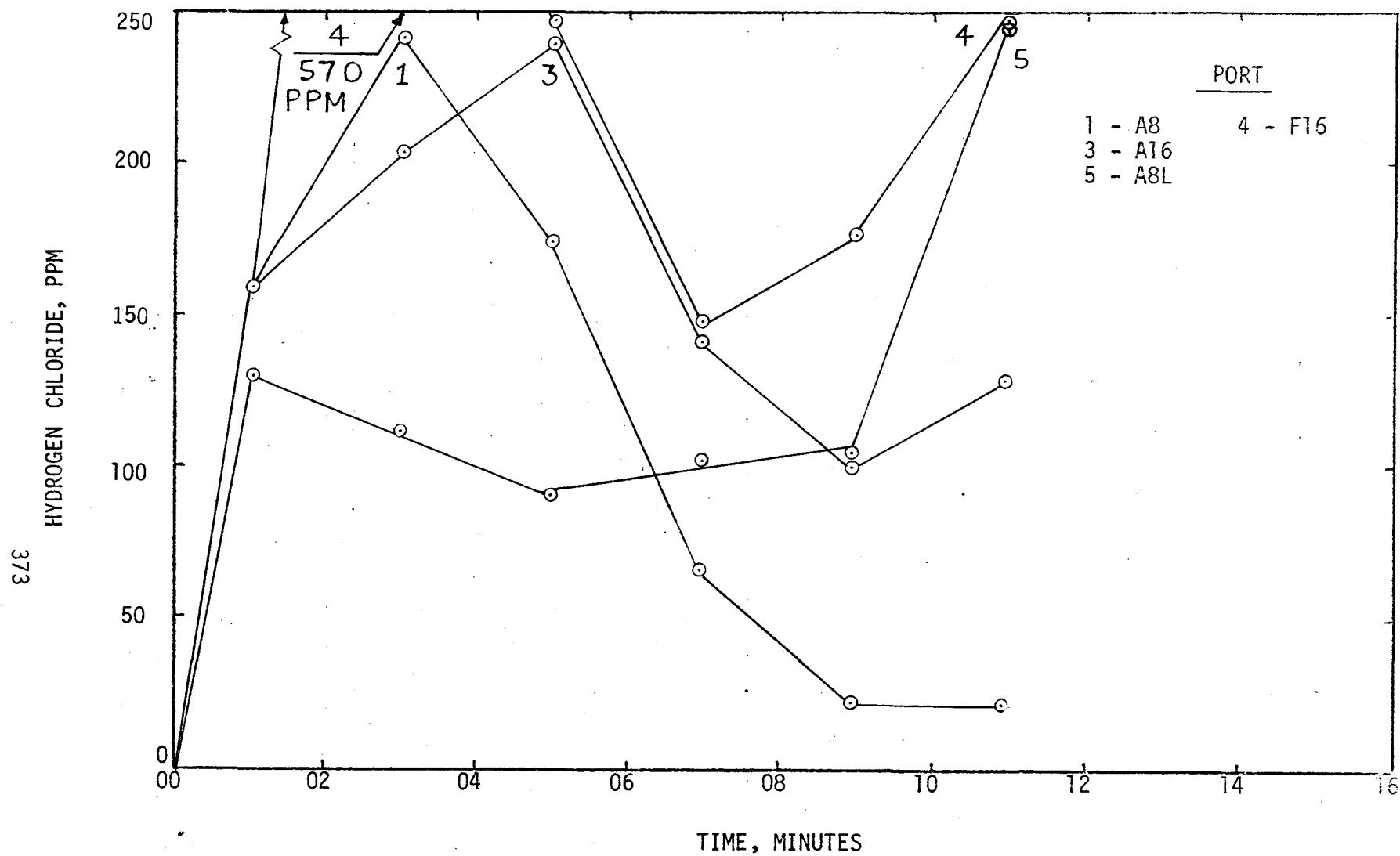


FIGURE 278 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 15

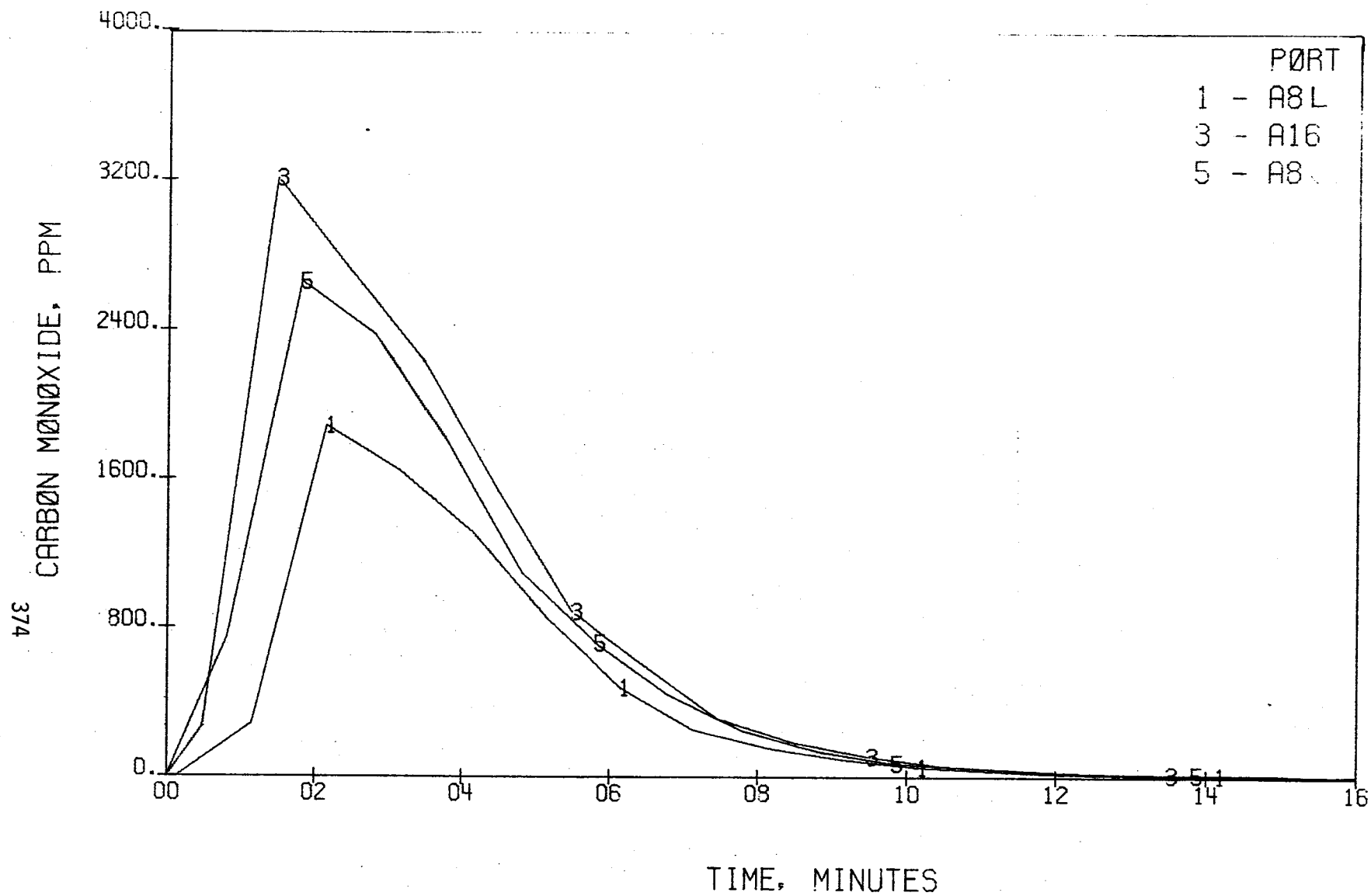


FIGURE 279 . - CARBON MONOXIDE CONCENTRATIONS , AFT  
TEST 15

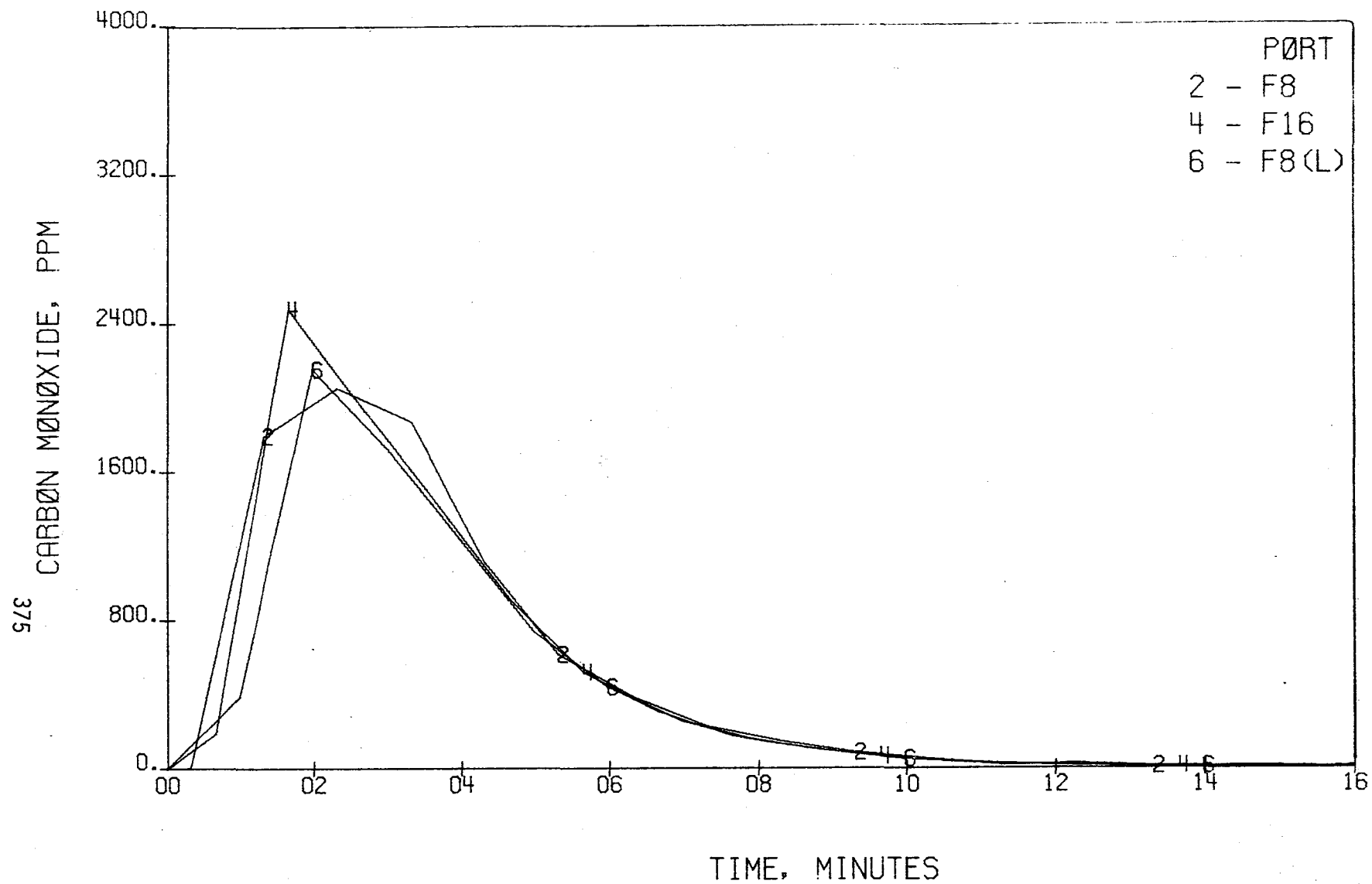


FIGURE 280 . - CARBON MONOXIDE CONCENTRATIONS, FØRE TEST 15

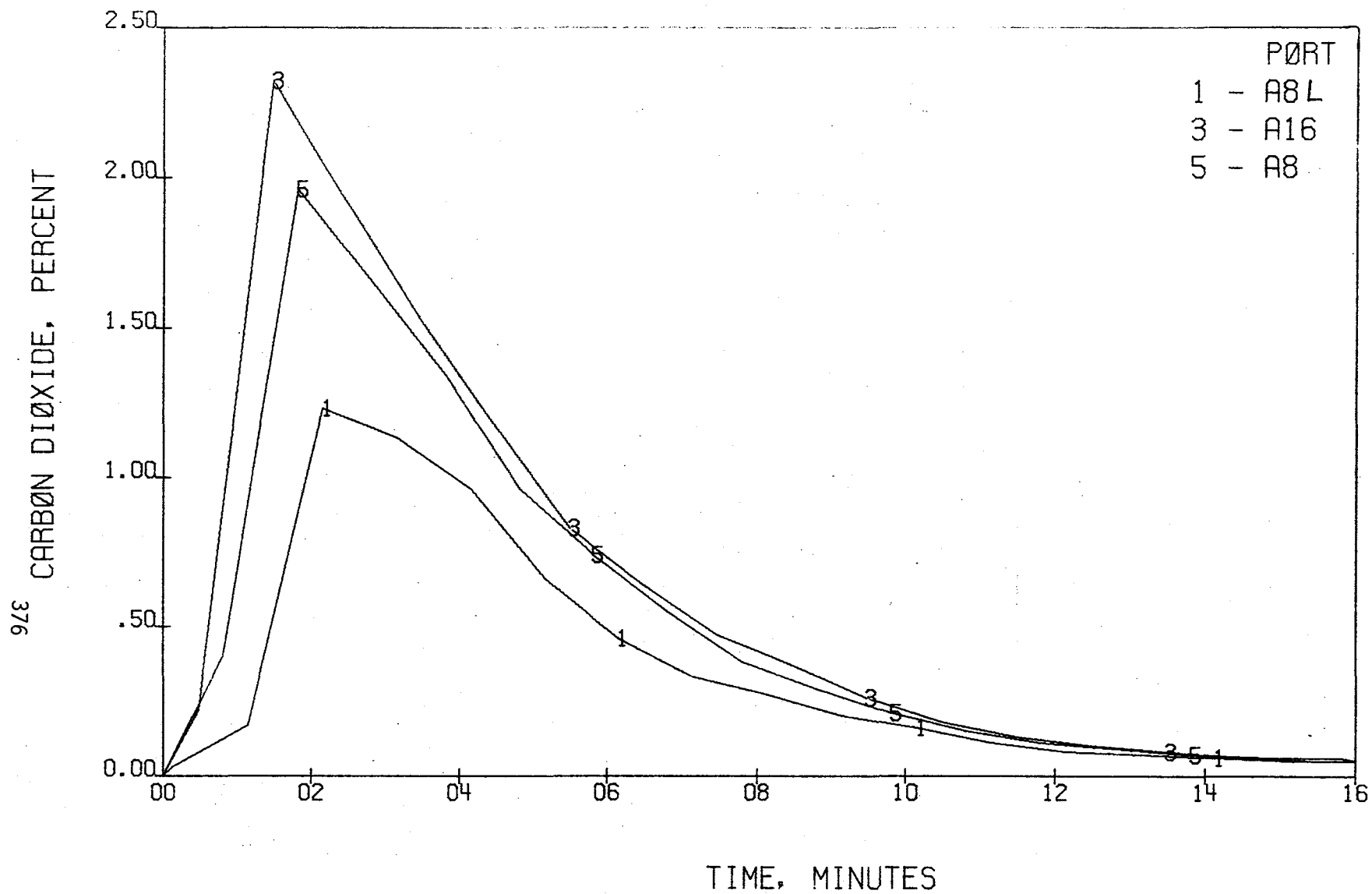


FIGURE 281 . - CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 15



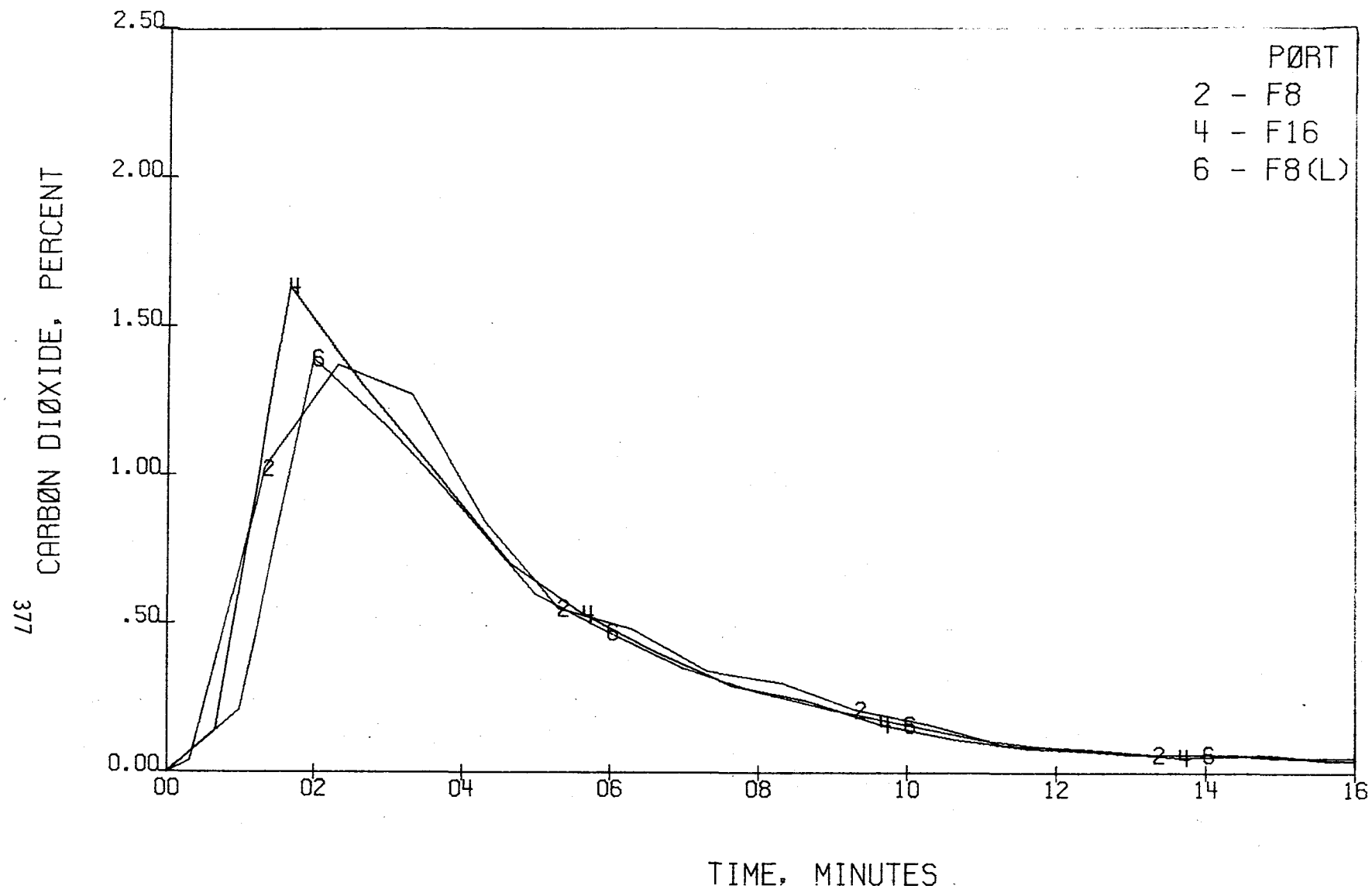


FIGURE 282 . - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 15

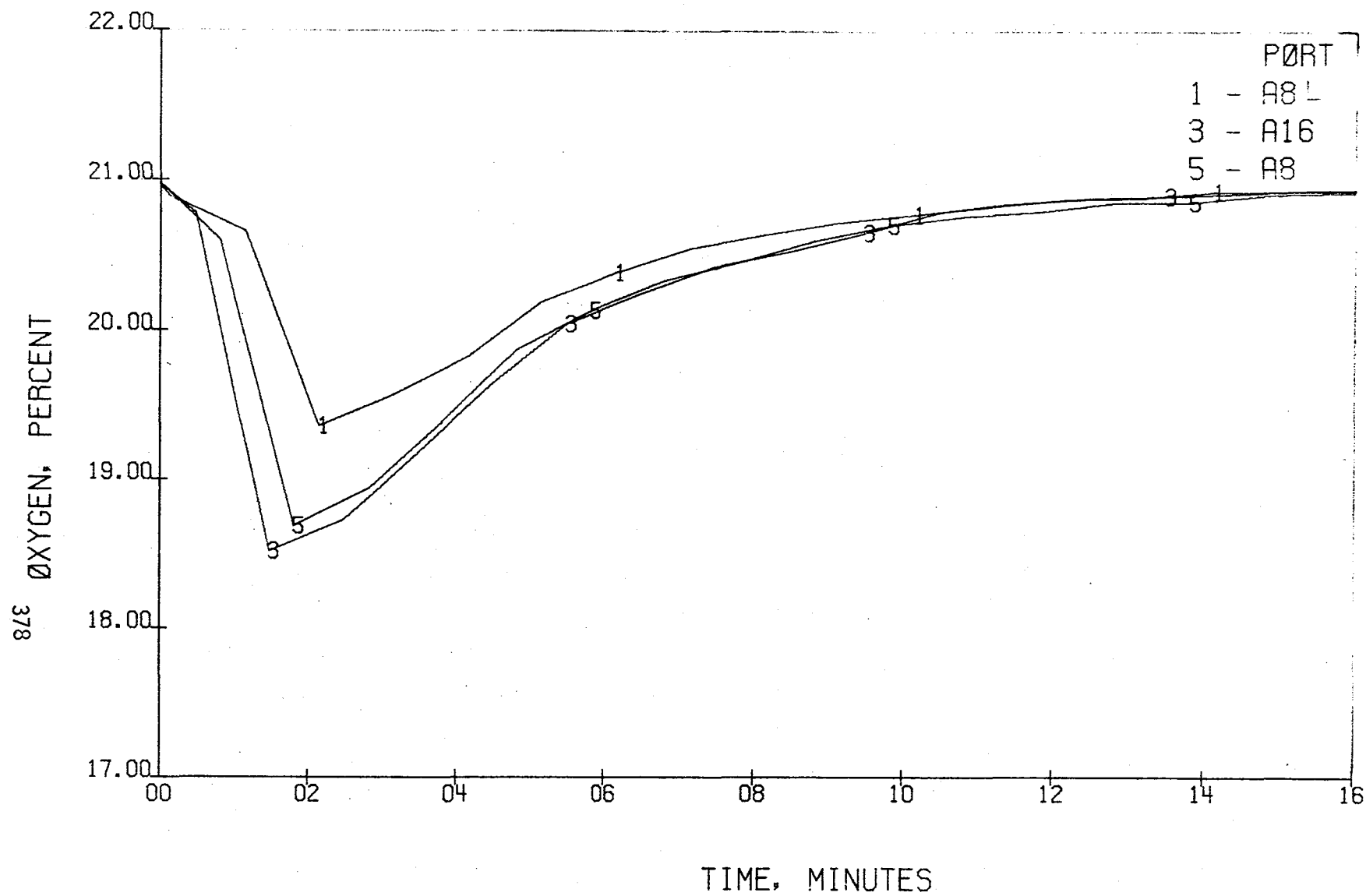


FIGURE 283 .- OXYGEN CONCENTRATIONS , AFT  
TEST 15

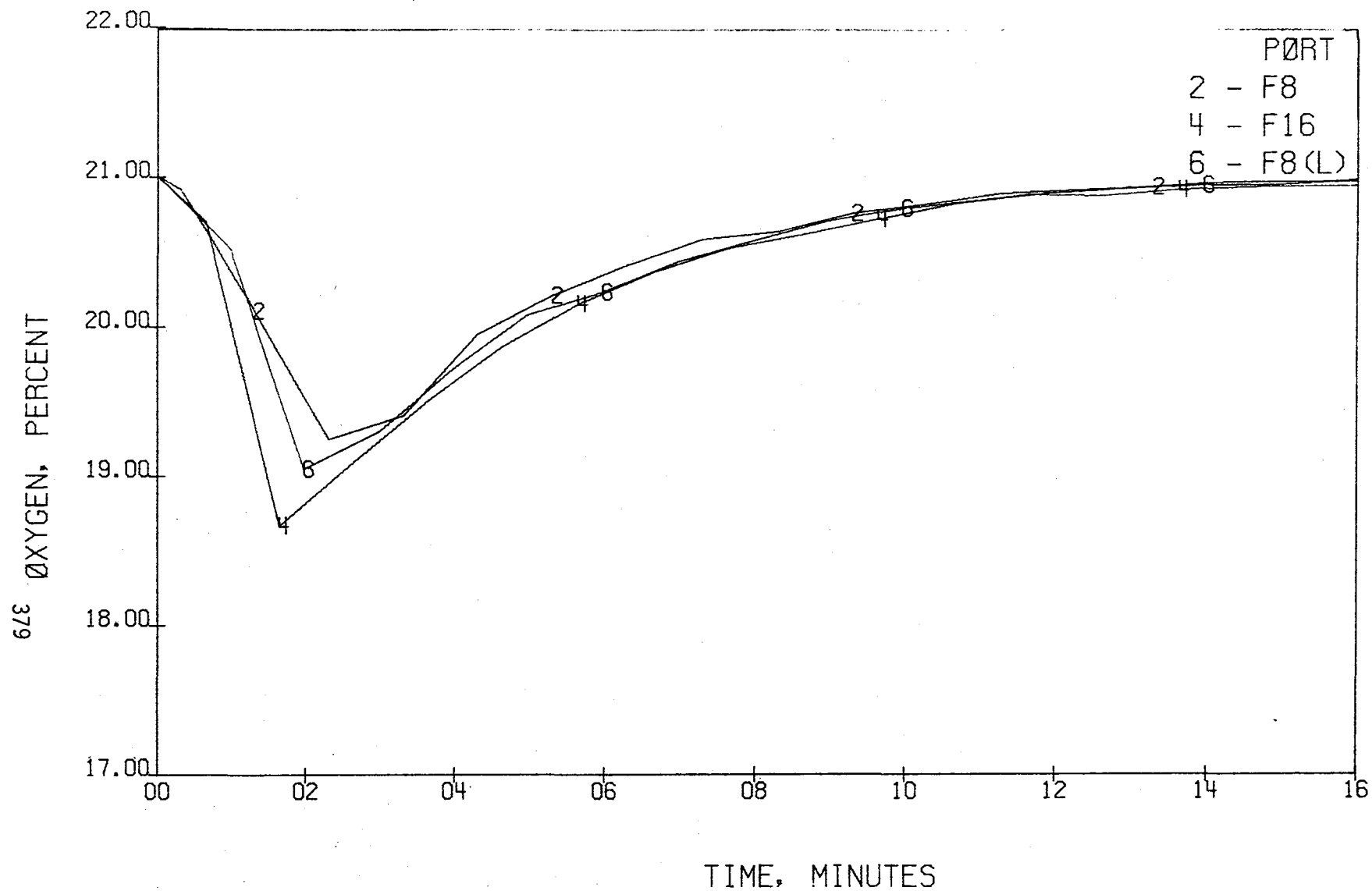


FIGURE 284 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 15

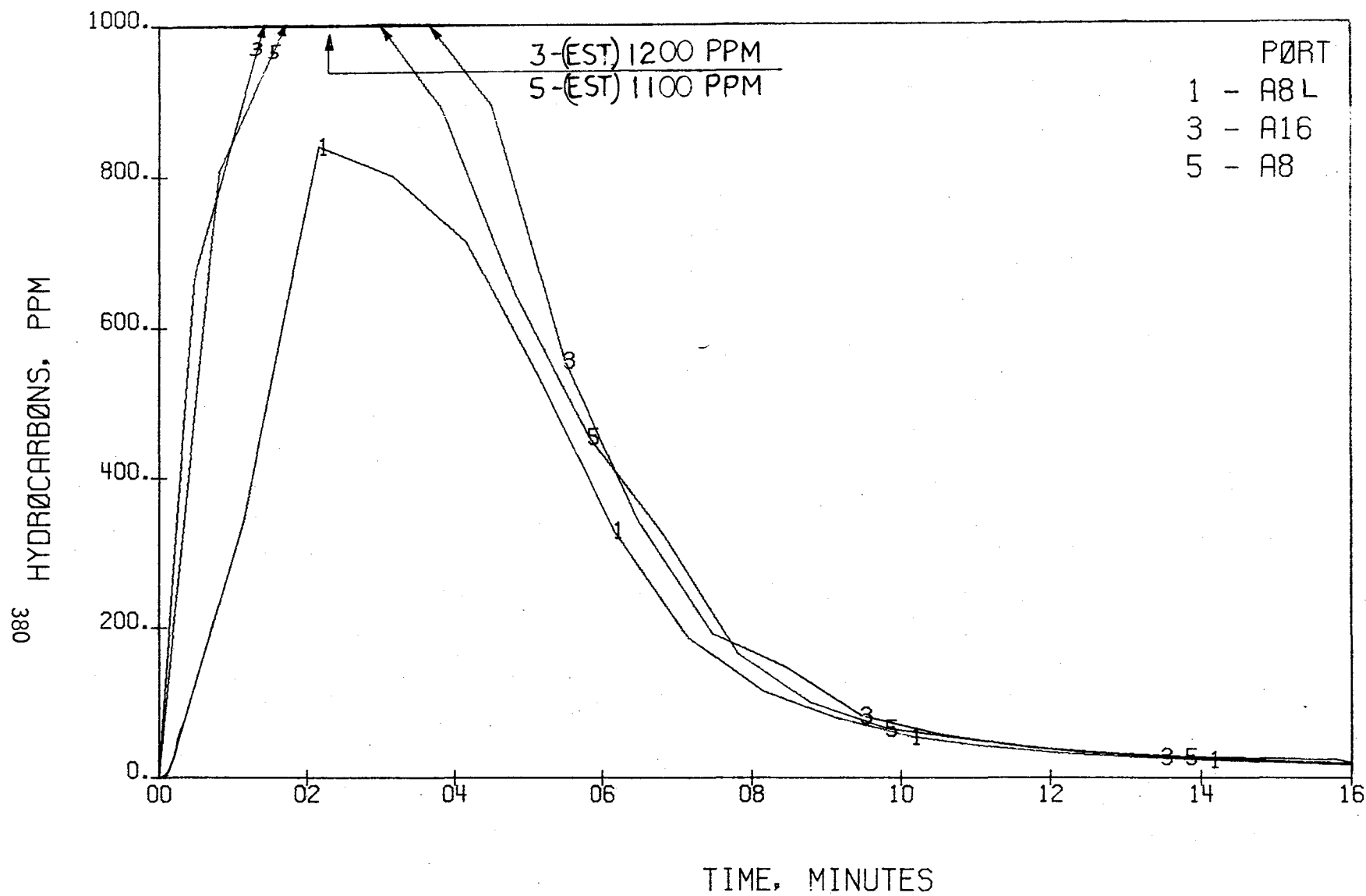


FIGURE 285 - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 15

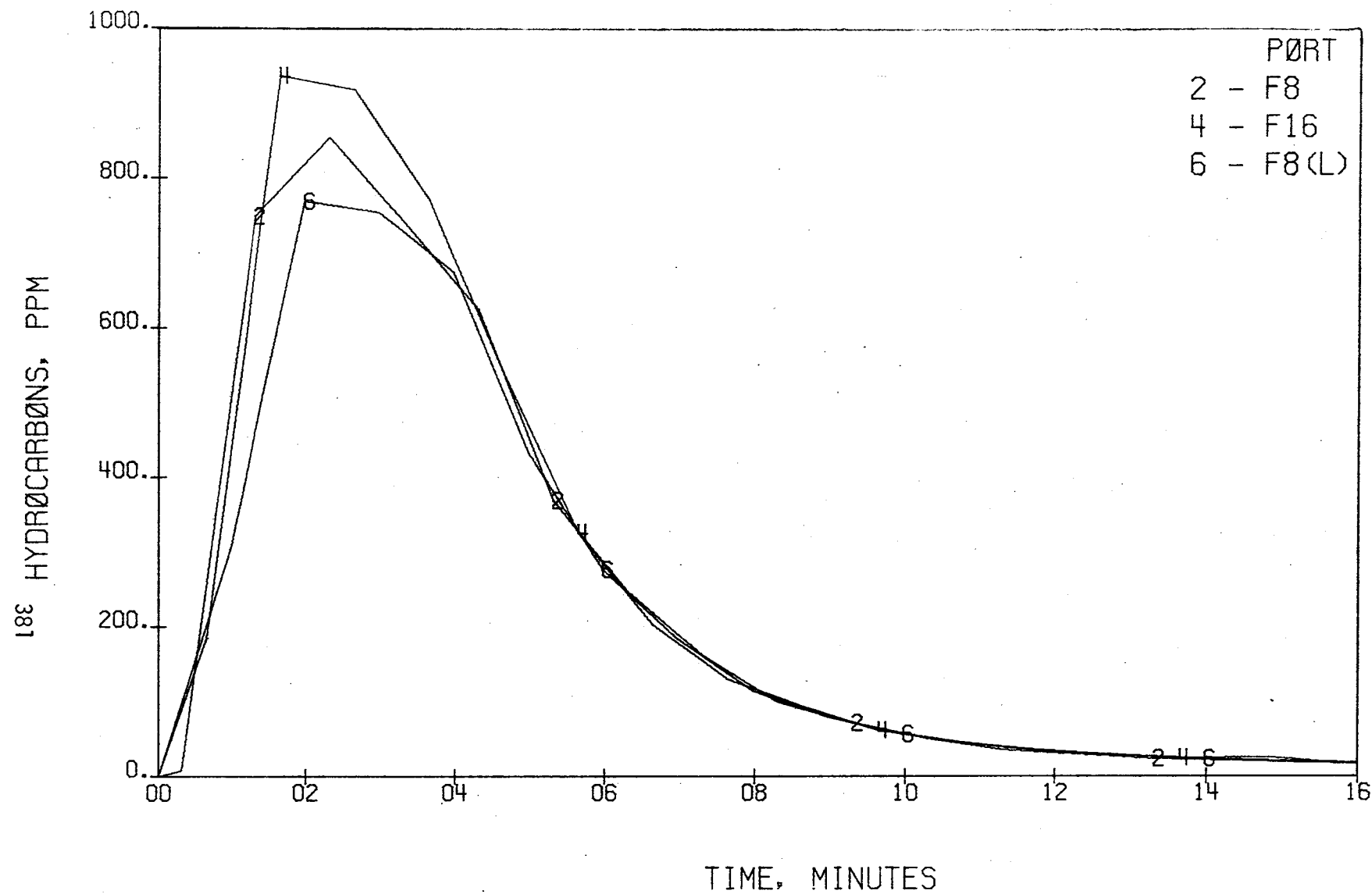


FIGURE 286 . - HYDRØCARBØNS CØNCENTRATIONS , FØRE  
TEST 15



TEST 16

---

BARE UPJOHN 9700 WFR FOAM SEATS

TEST 16

BARE UPJOHN 9700 WFR FOAM SEATS

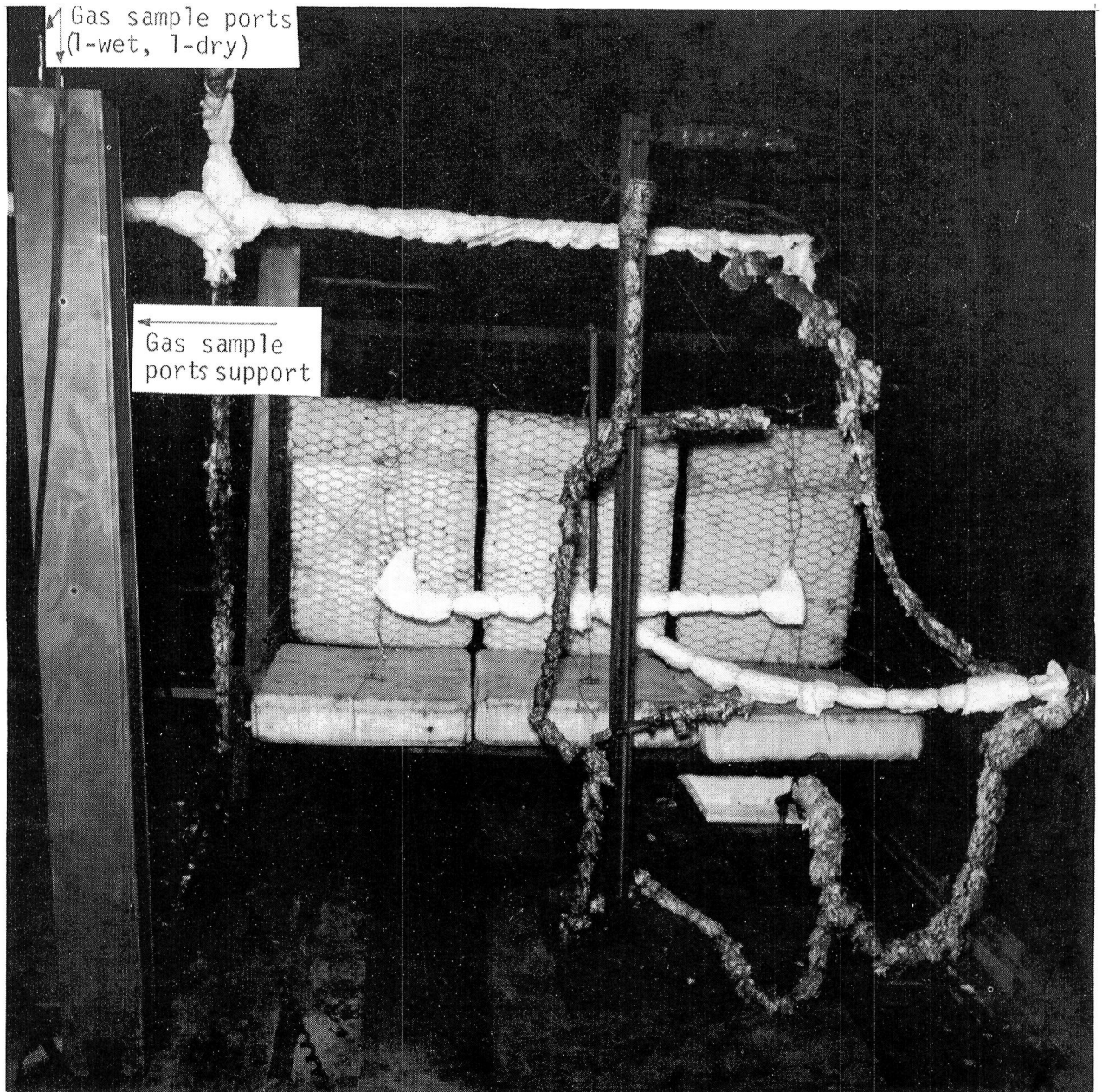


FIGURE 287 . - PRE-TEST CONFIGURATION, TEST 16



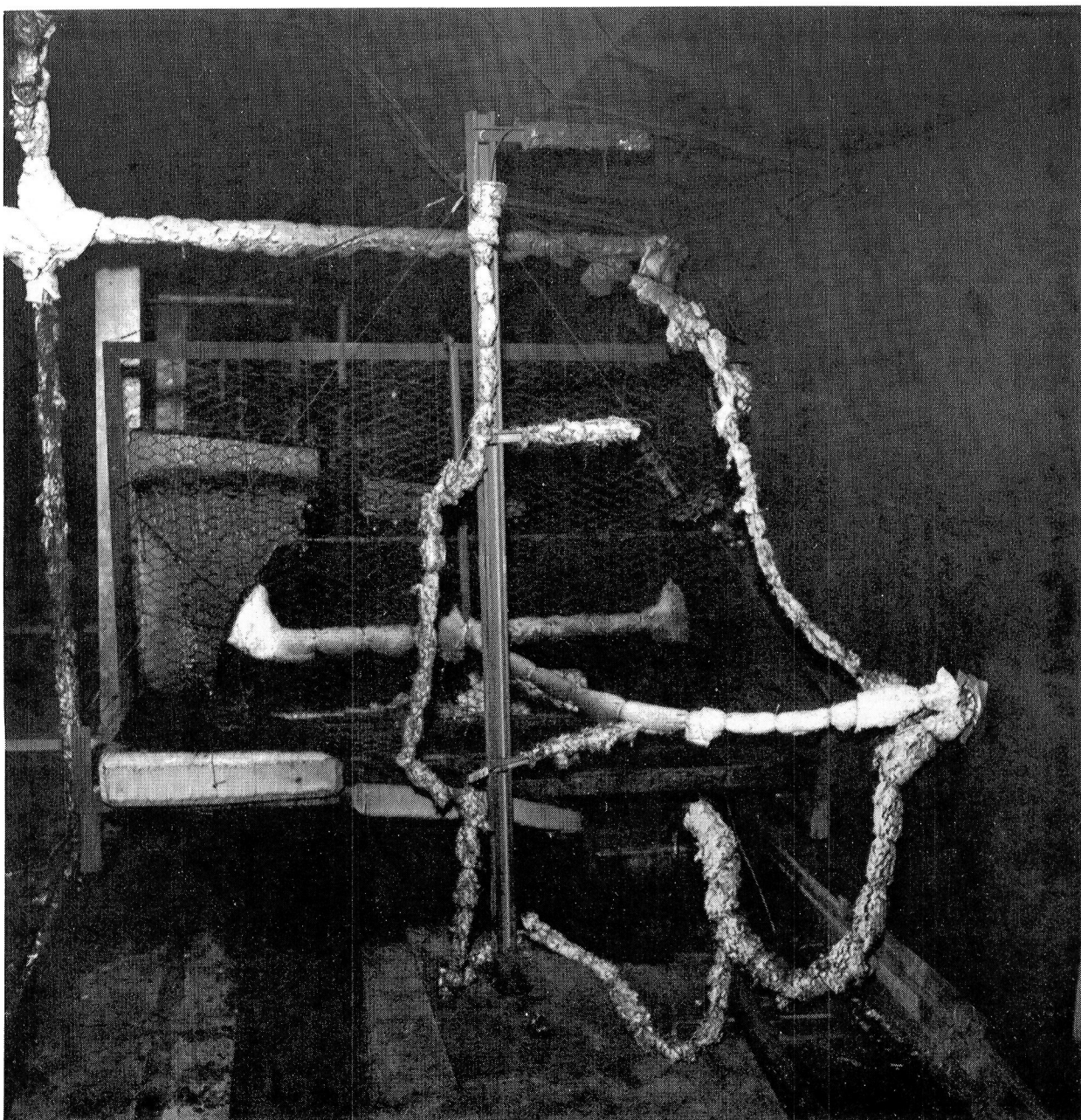


FIGURE 288 . - POST-TEST CONFIGURATION, TEST 16



FIGURE 289 . - FIRE DURING TEST 16

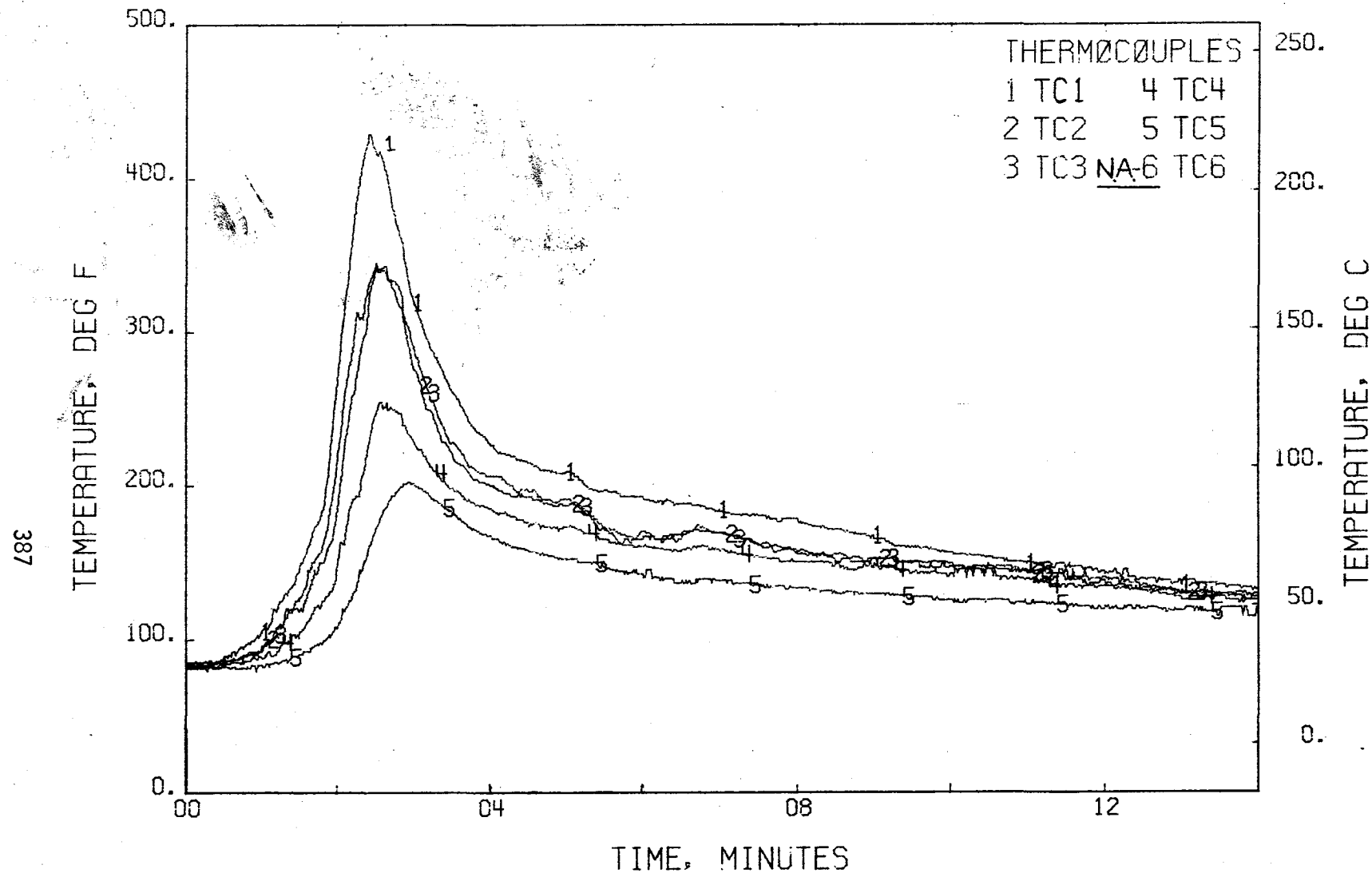
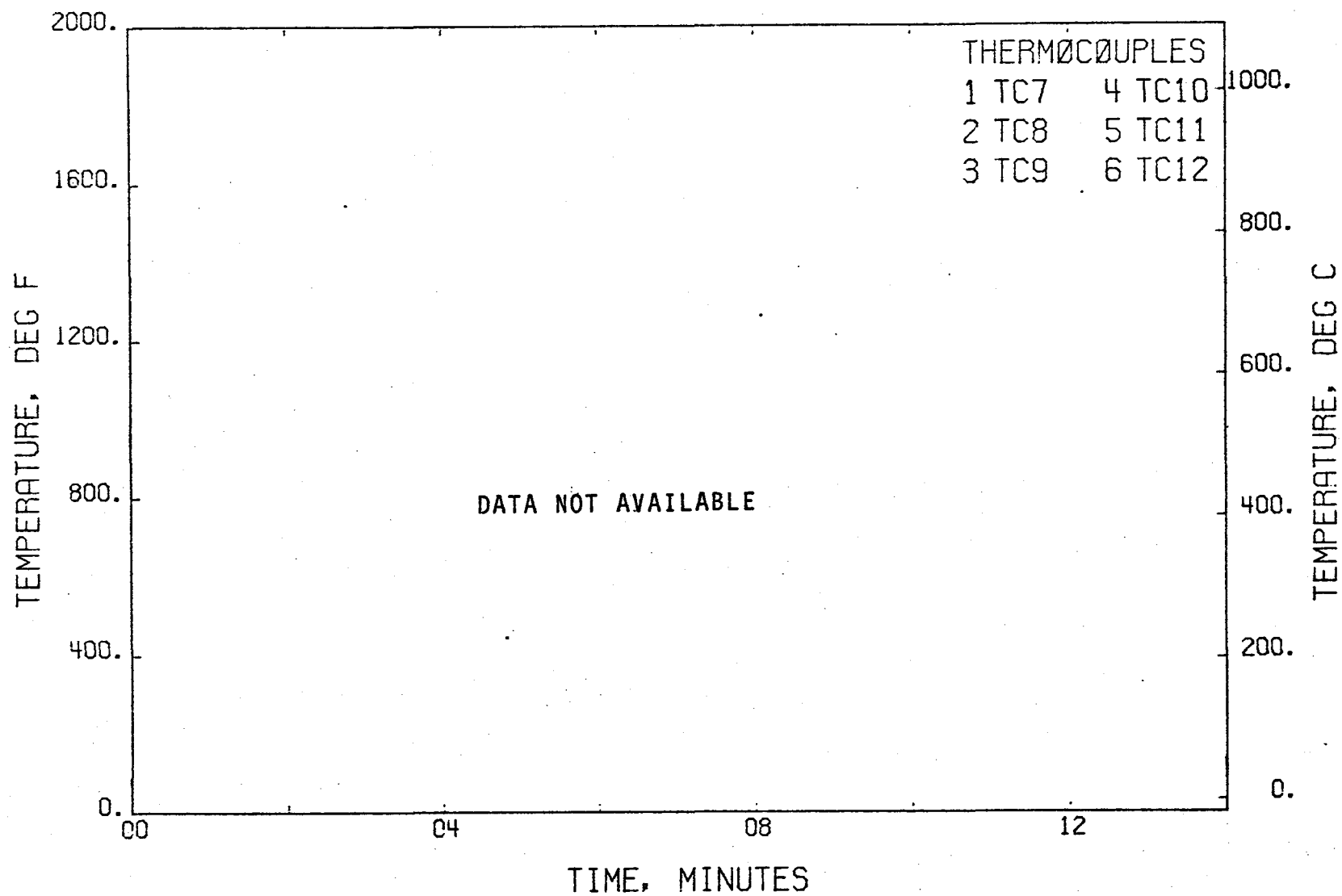


FIGURE 290 . - TEMPERATURES, T/C TREE 1  
TEST 16

888



TEMPERATURES, T/C TREE 2  
TEST 16

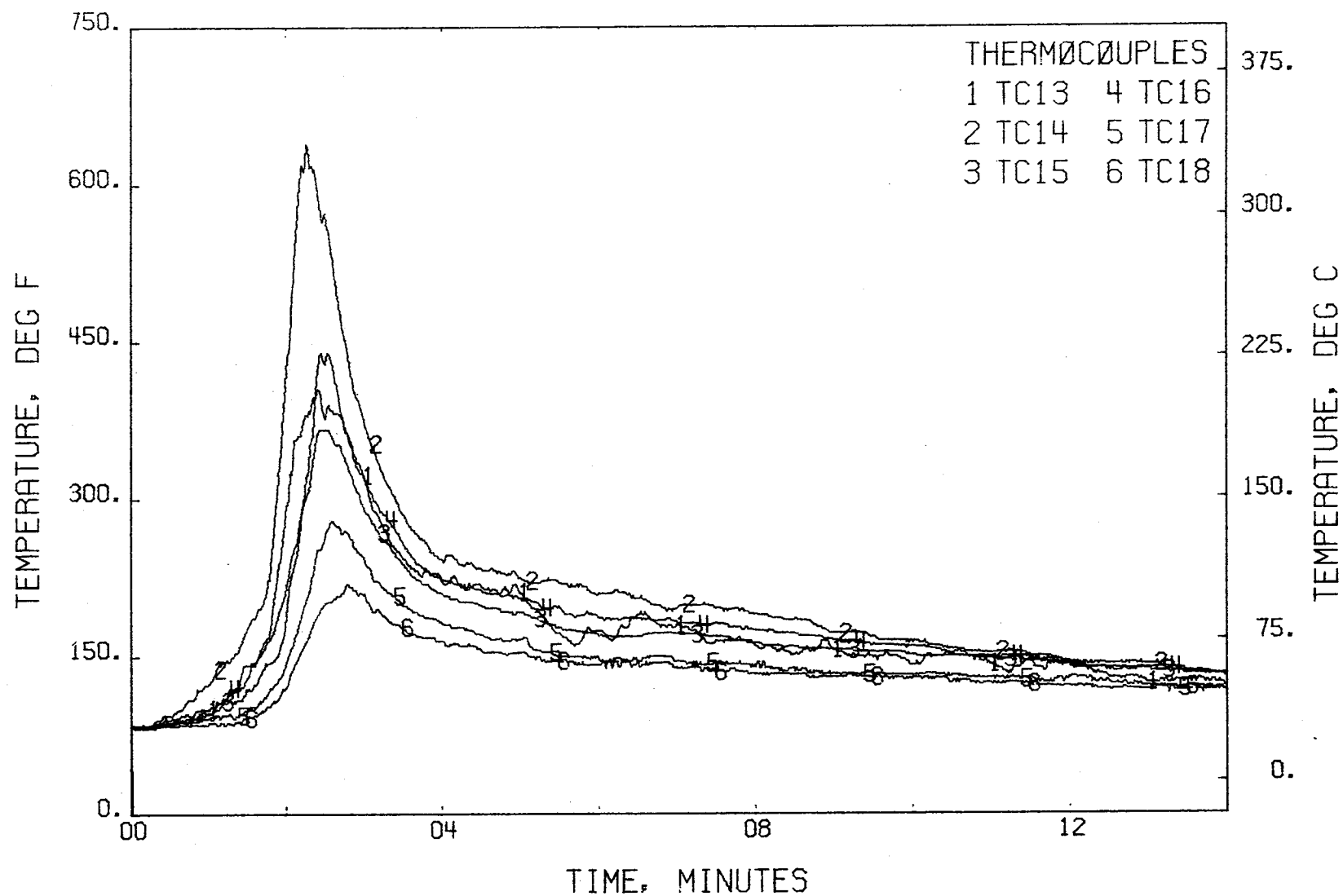


FIGURE 291 . - TEMPERATURES, T/C TREE 3  
TEST 16

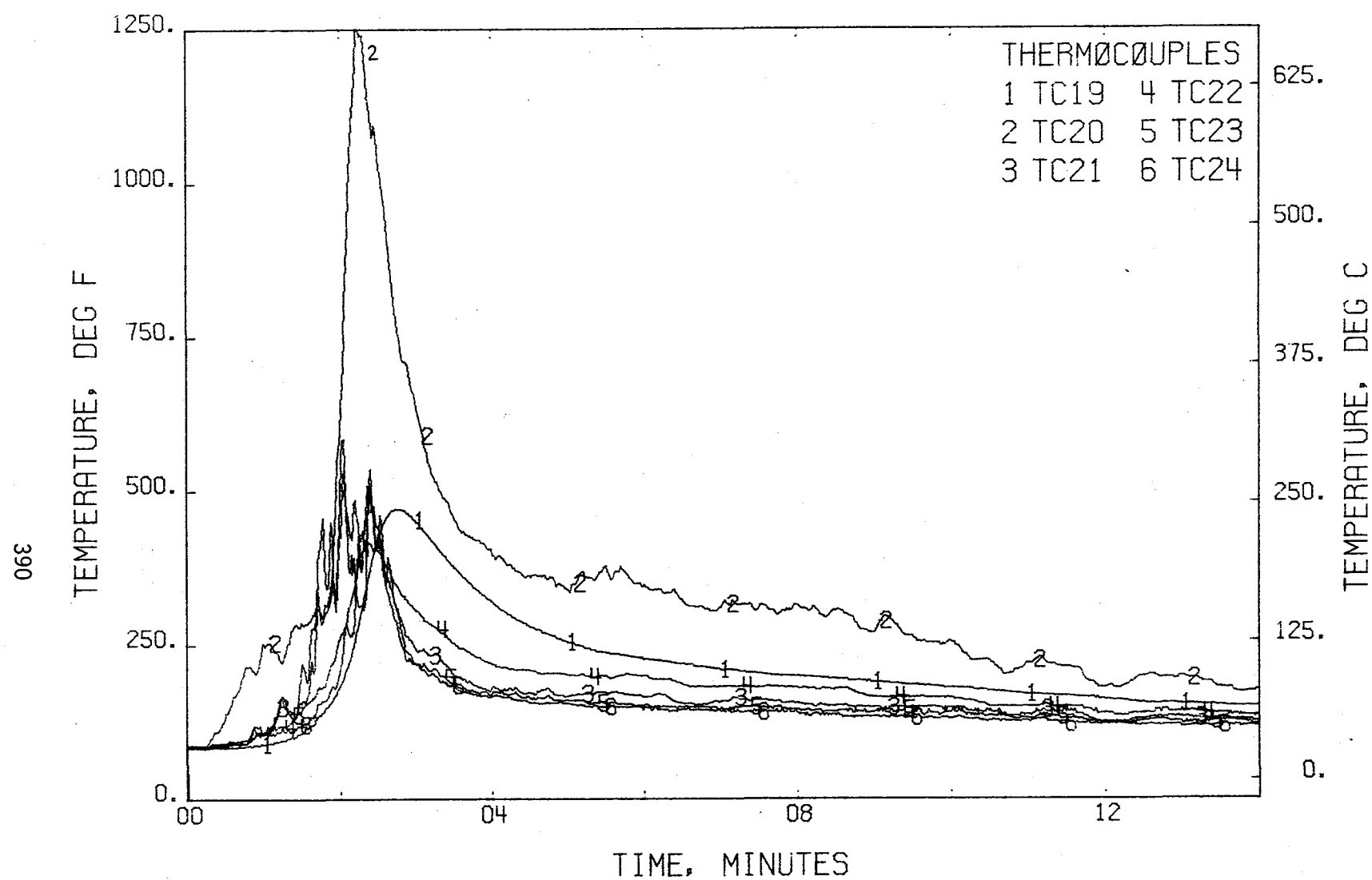


FIGURE 292 . - TEMPERATURES, T/C TREE 4  
TEST 16

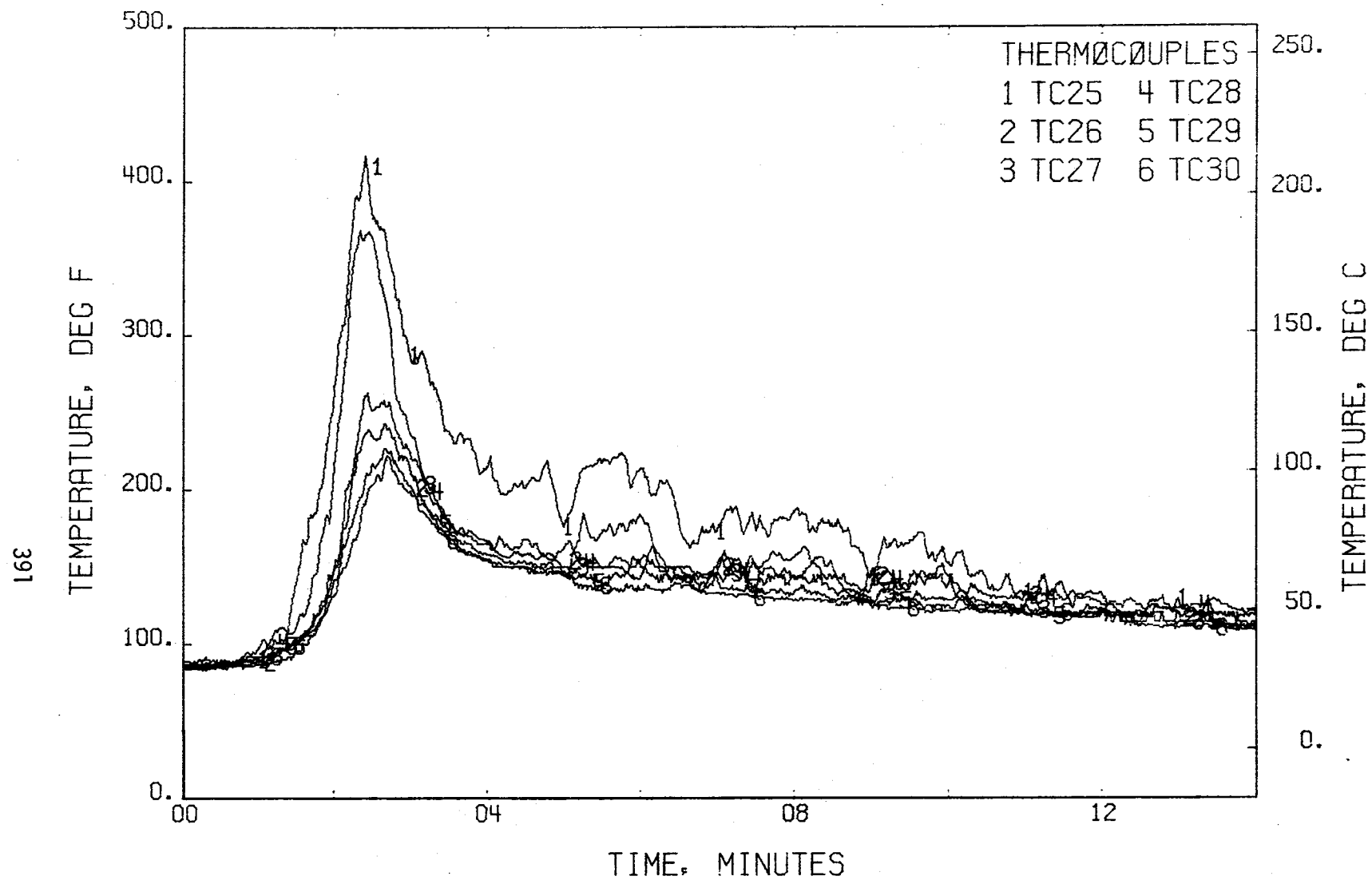
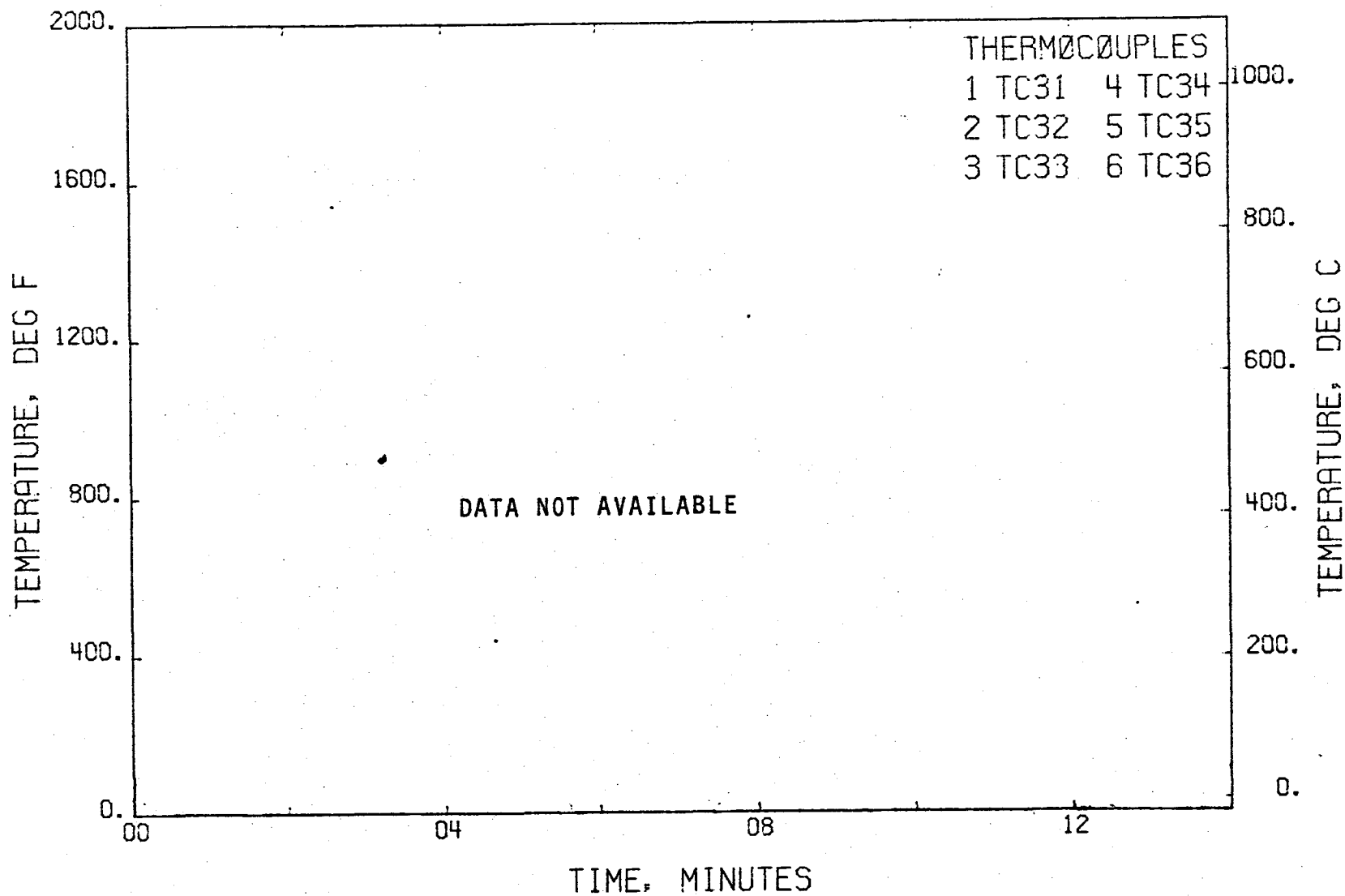


FIGURE 293 . - TEMPERATURES, T/C TREE 5  
TEST 16

392



TEMPERATURES, T/C TREE 6  
TEST 16



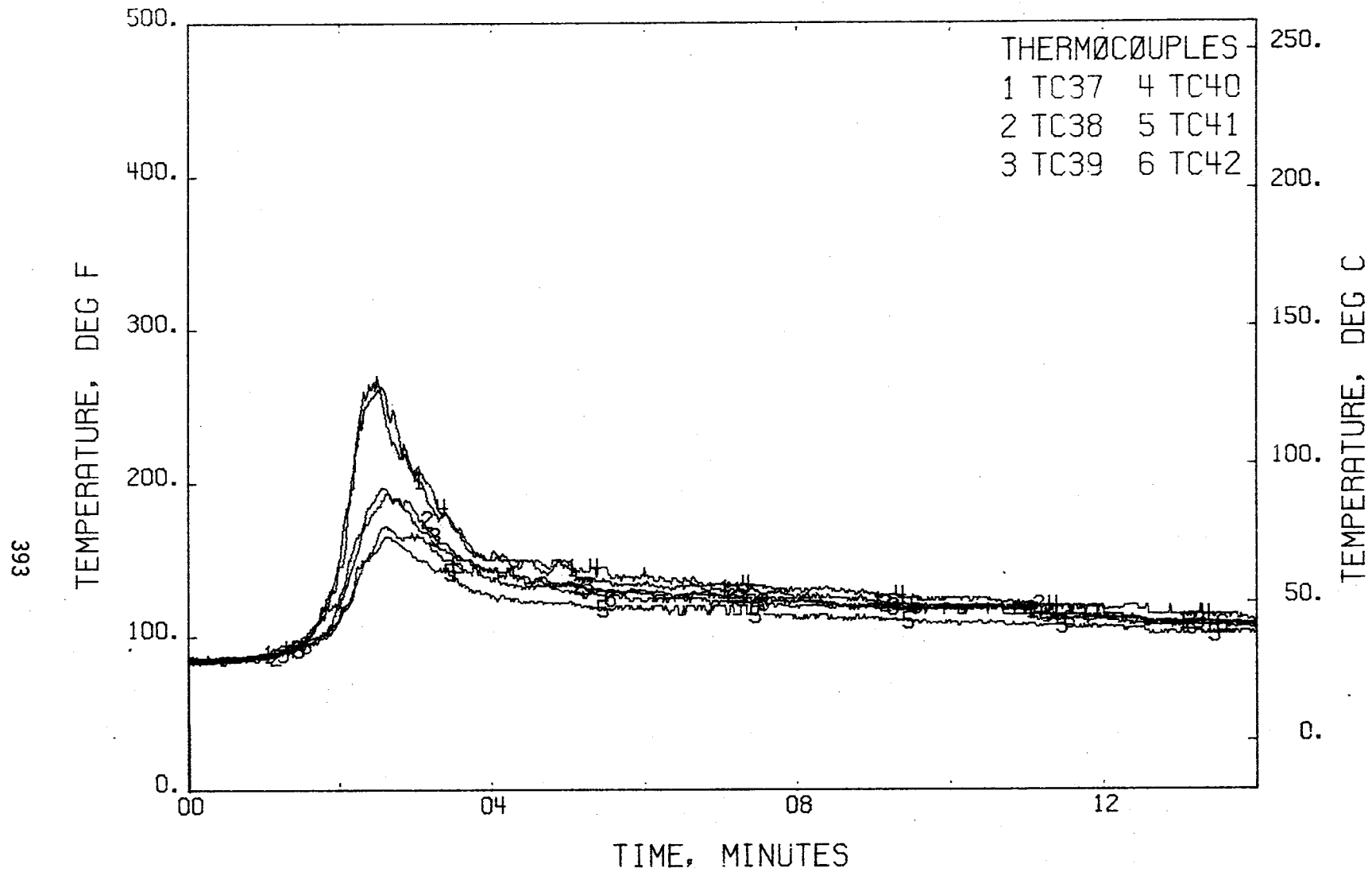


FIGURE 294 . - TEMPERATURES, T/C TREE 7  
TEST 16

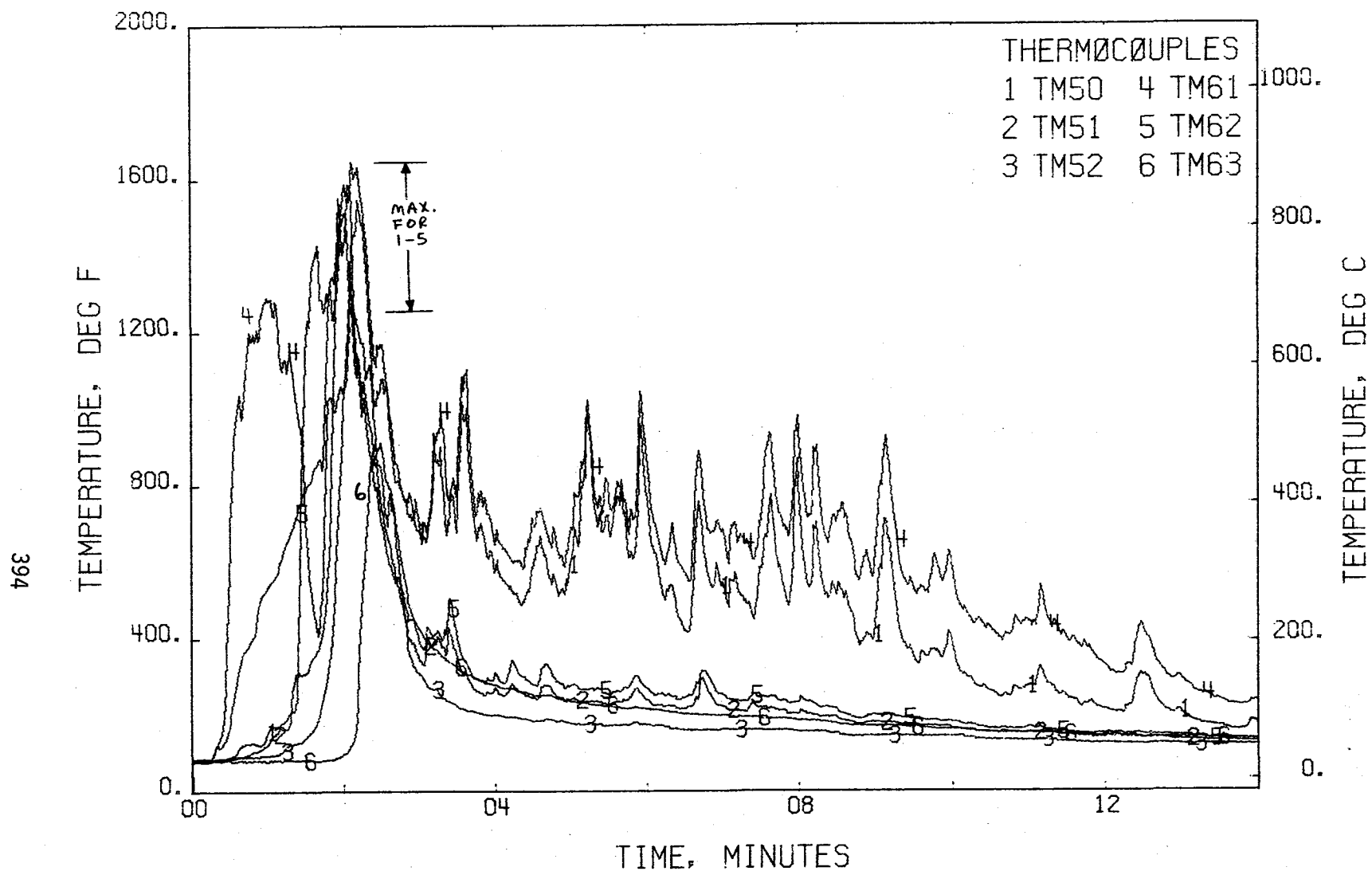


FIGURE 295 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 16

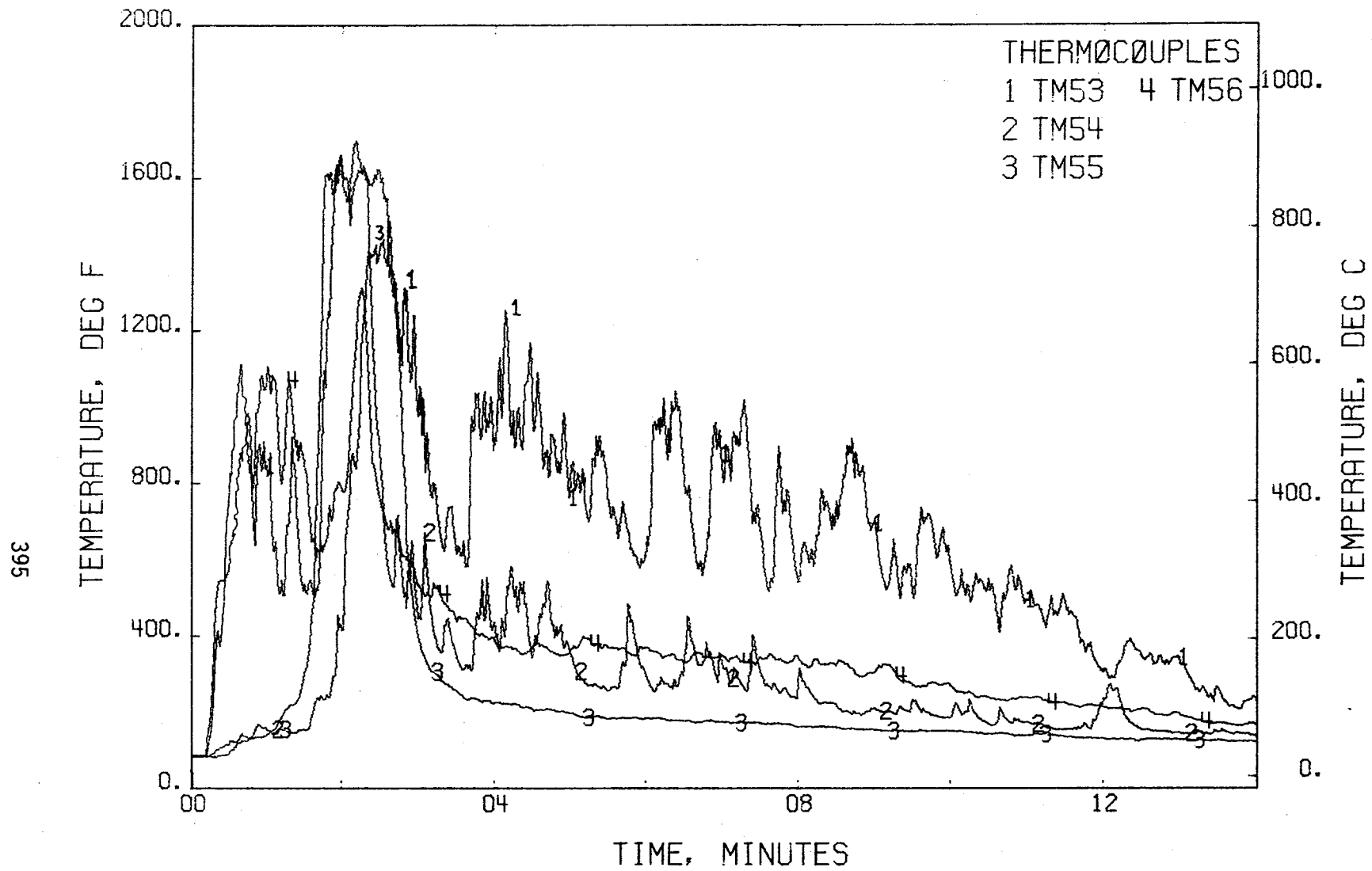


FIGURE 296 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 16

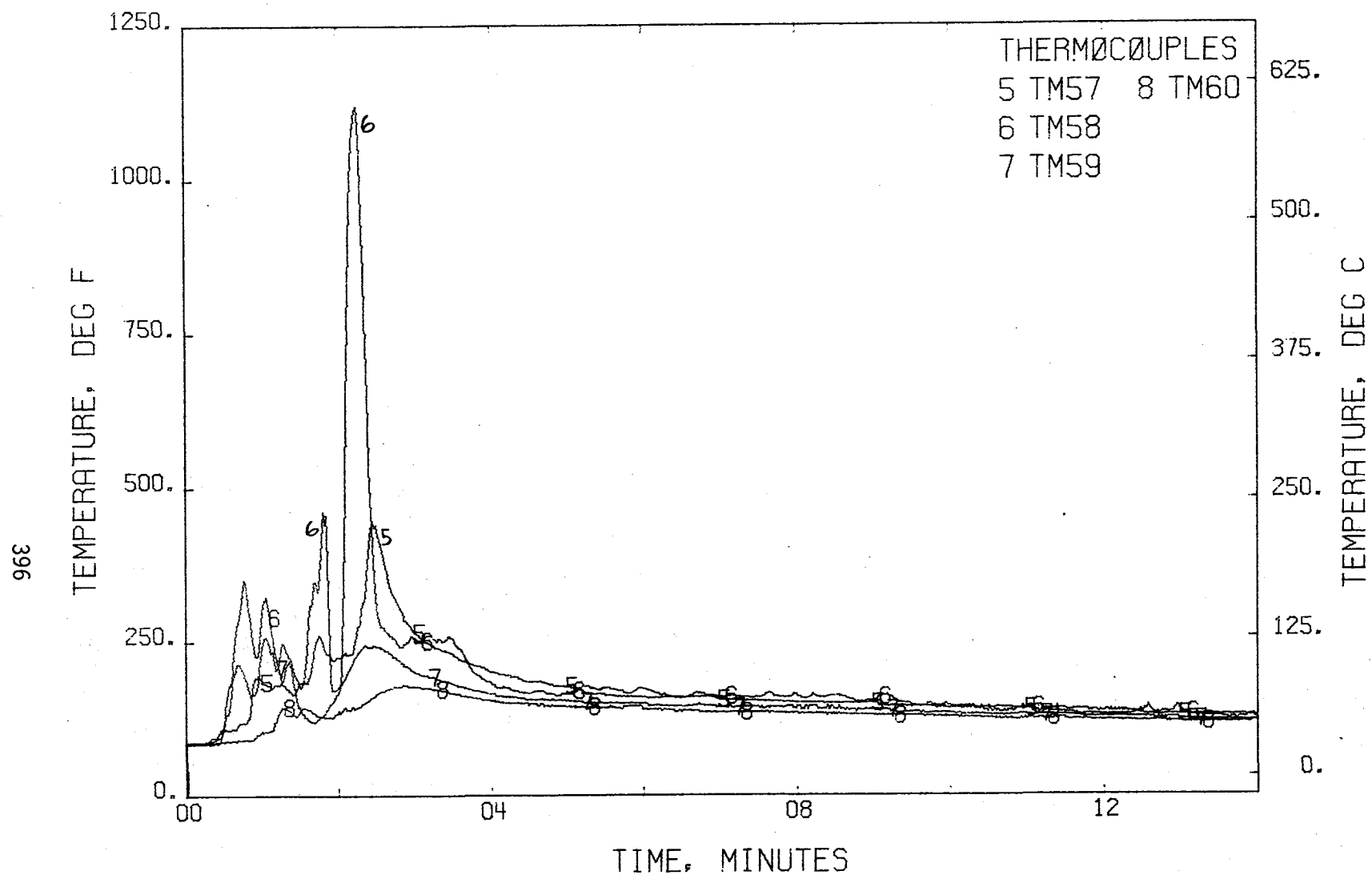


FIGURE 296 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 16

397

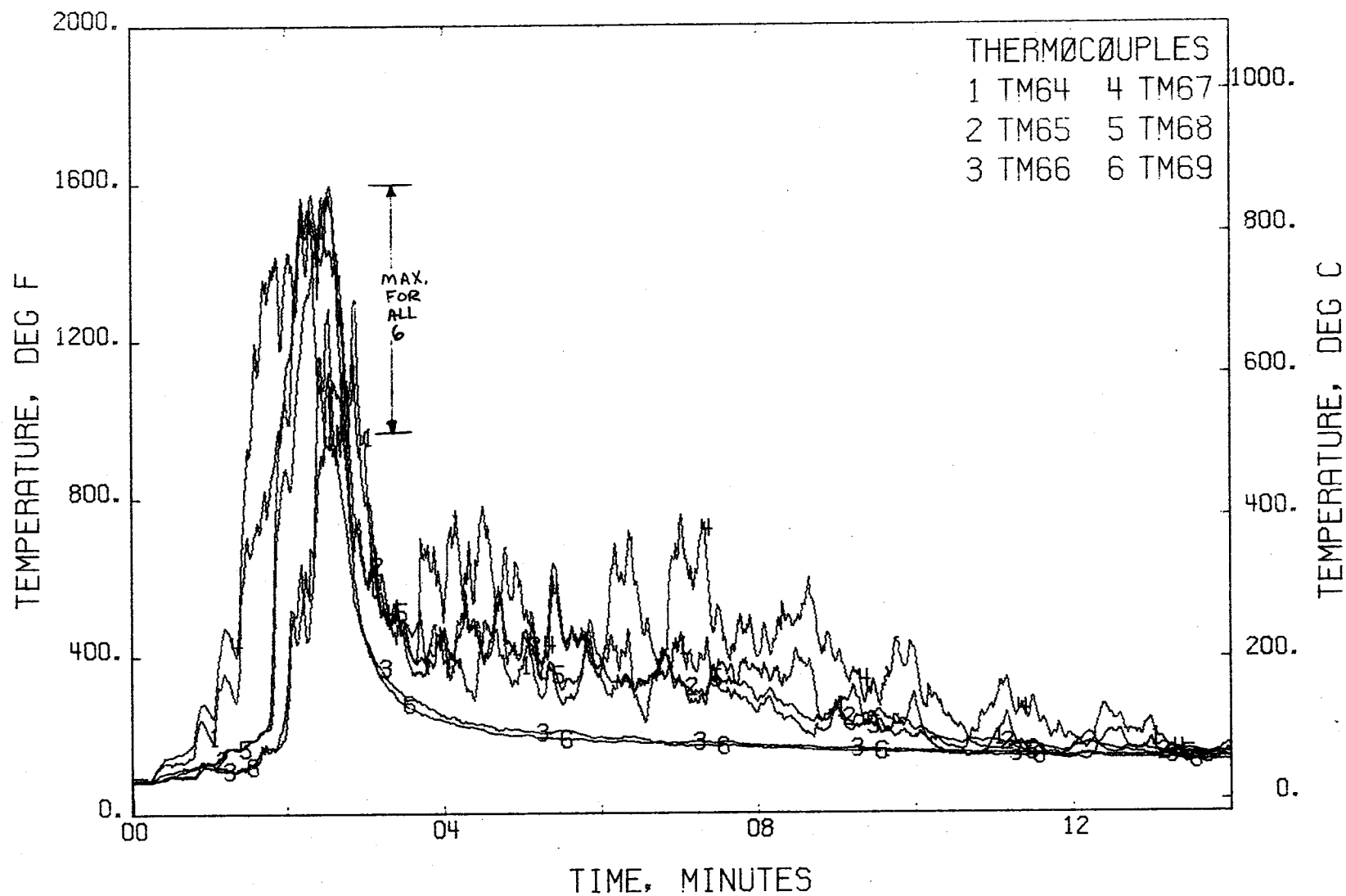


FIGURE 297 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 16

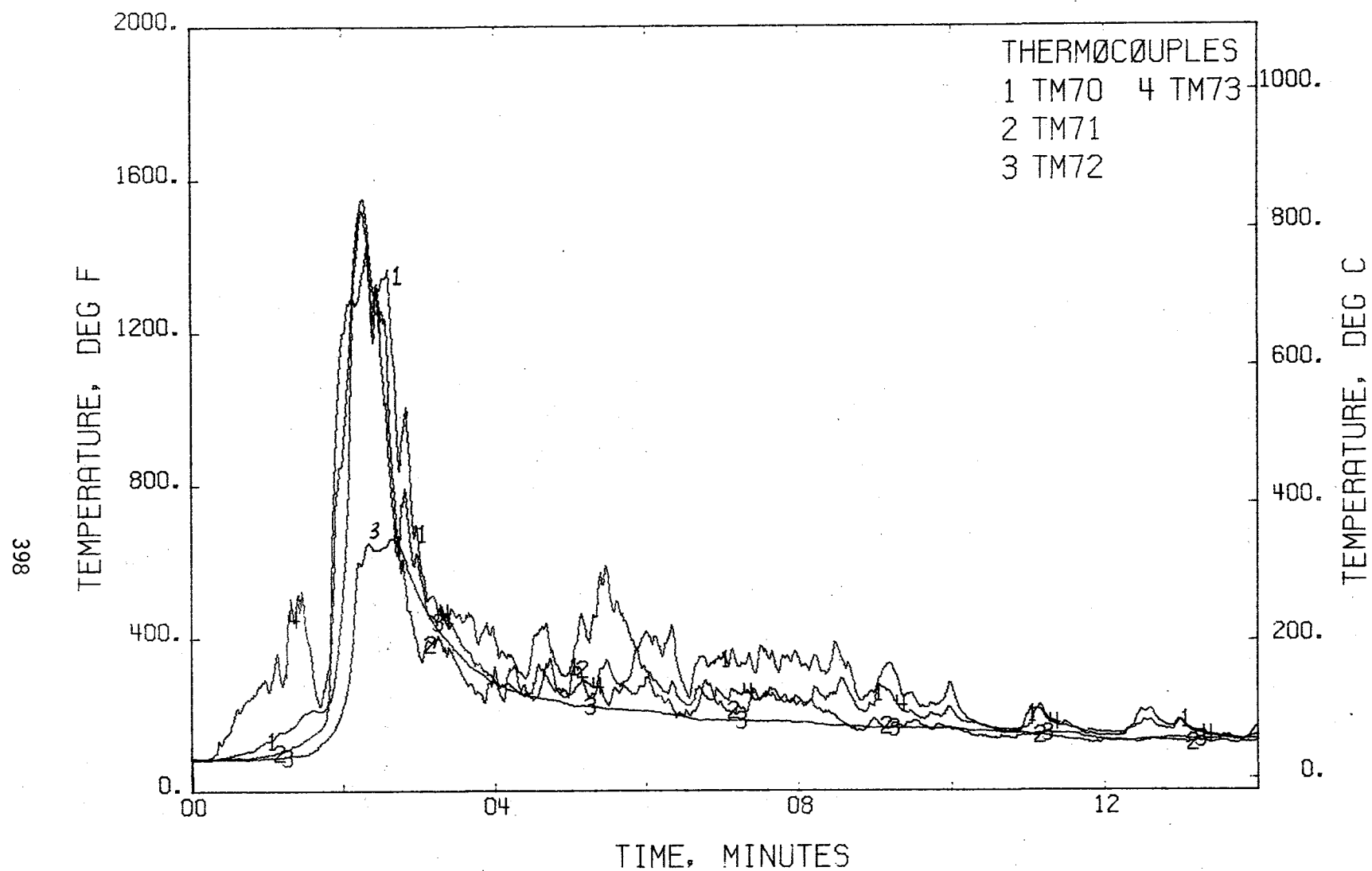


FIGURE 298 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 16

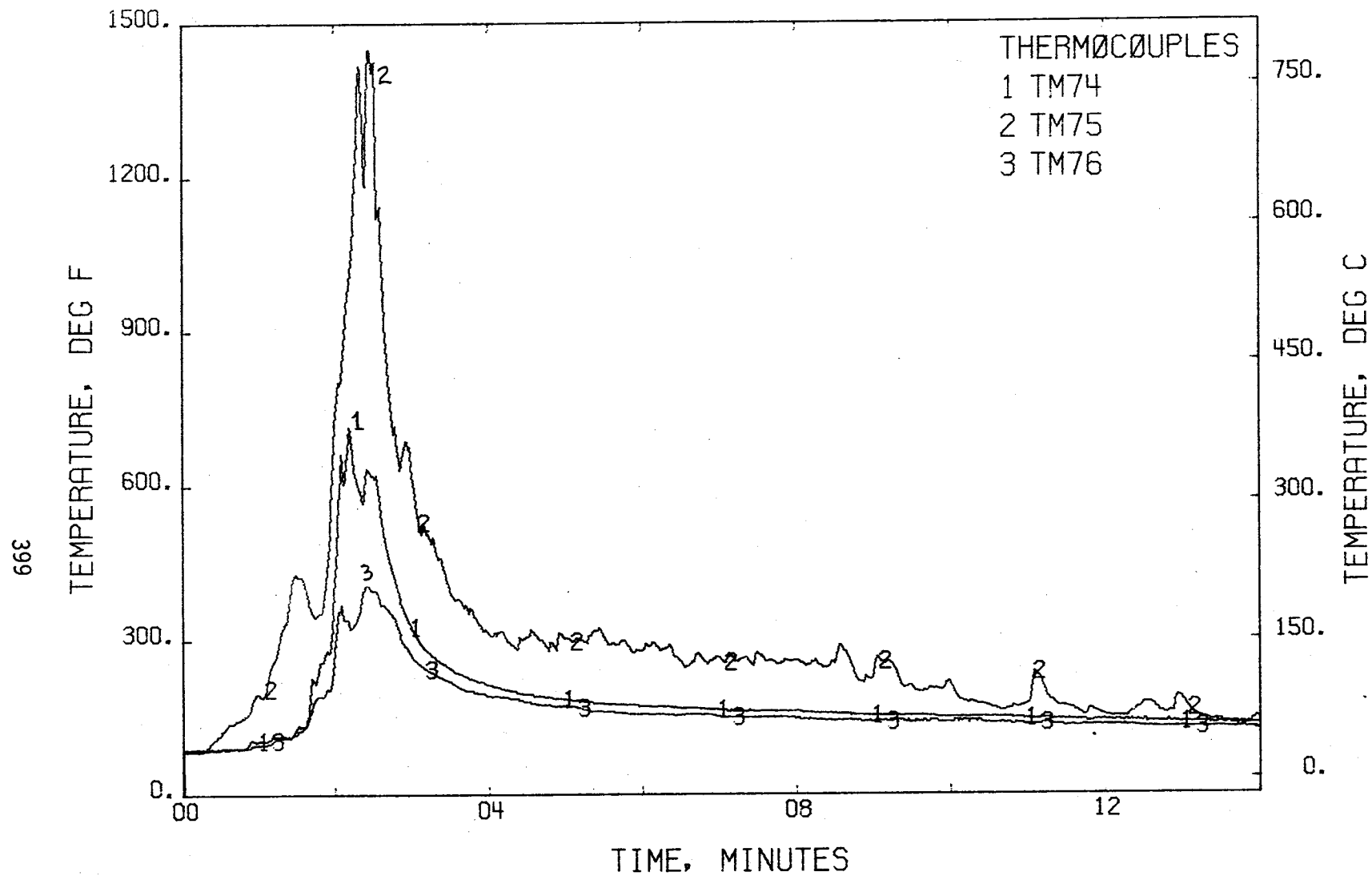


FIGURE 298 . - TEMPERATURES, SEAT BACK (EDGES)-CONT.  
TEST 16

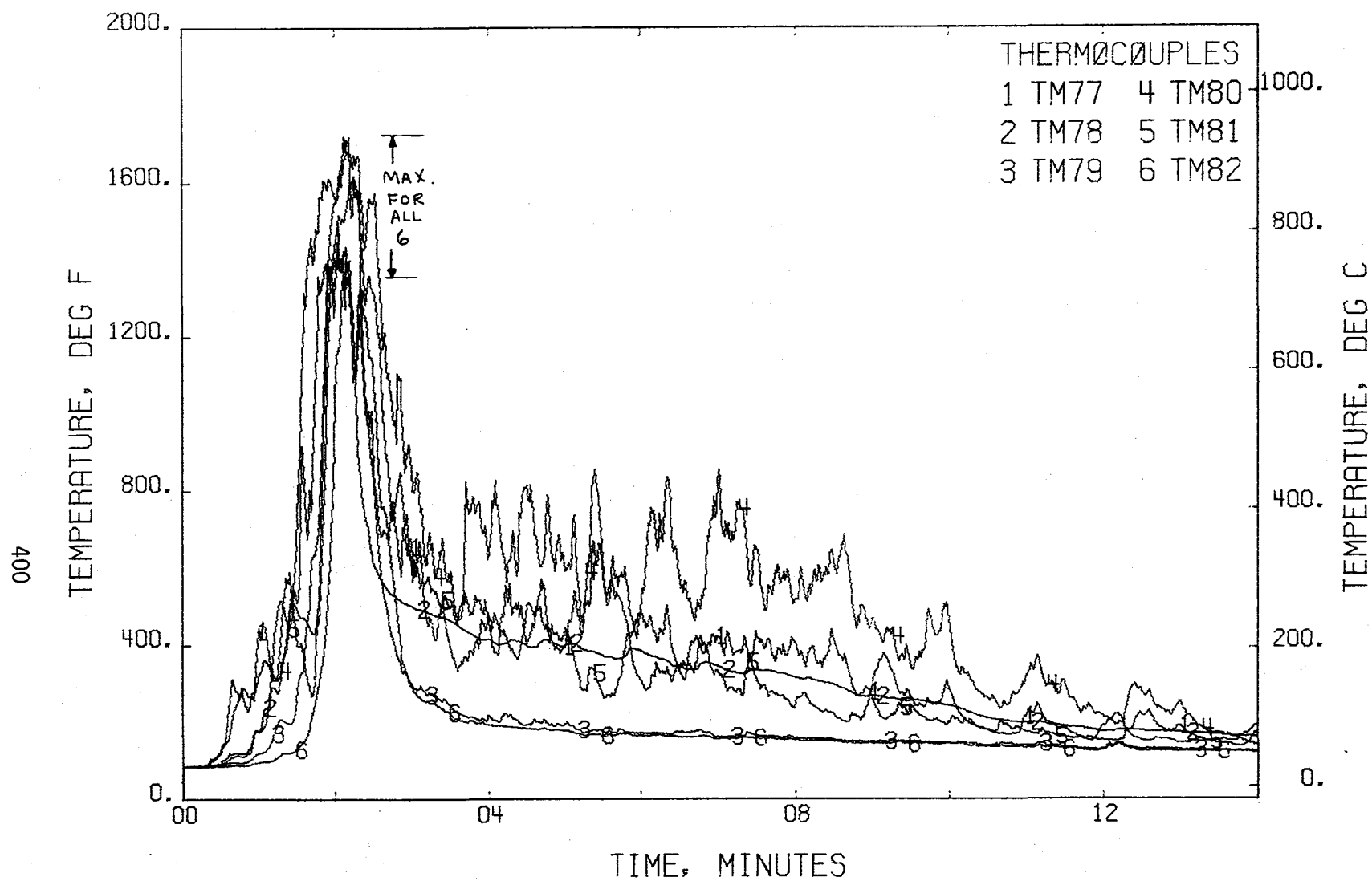


FIGURE 299 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 16



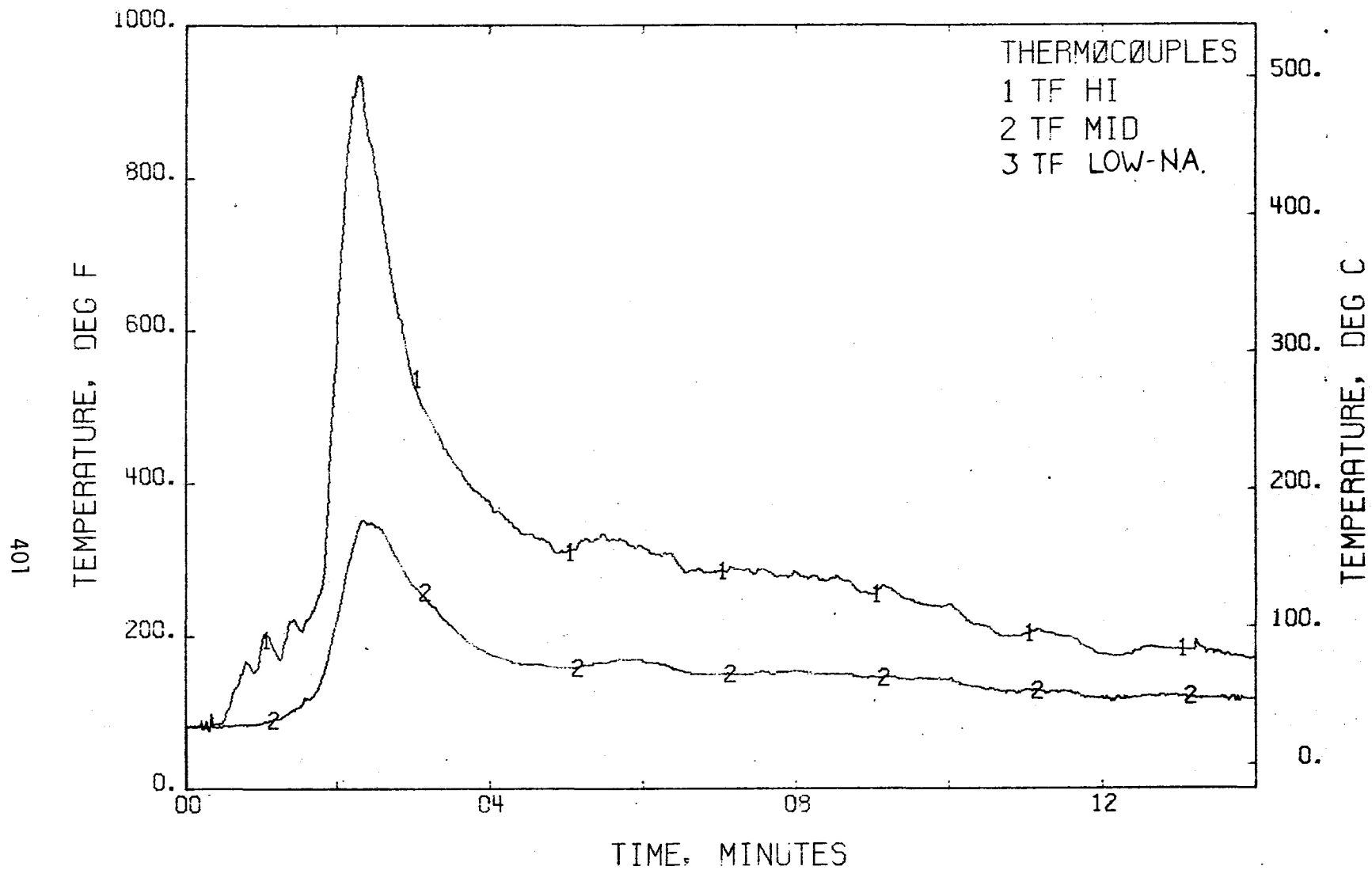


FIGURE 300 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 16

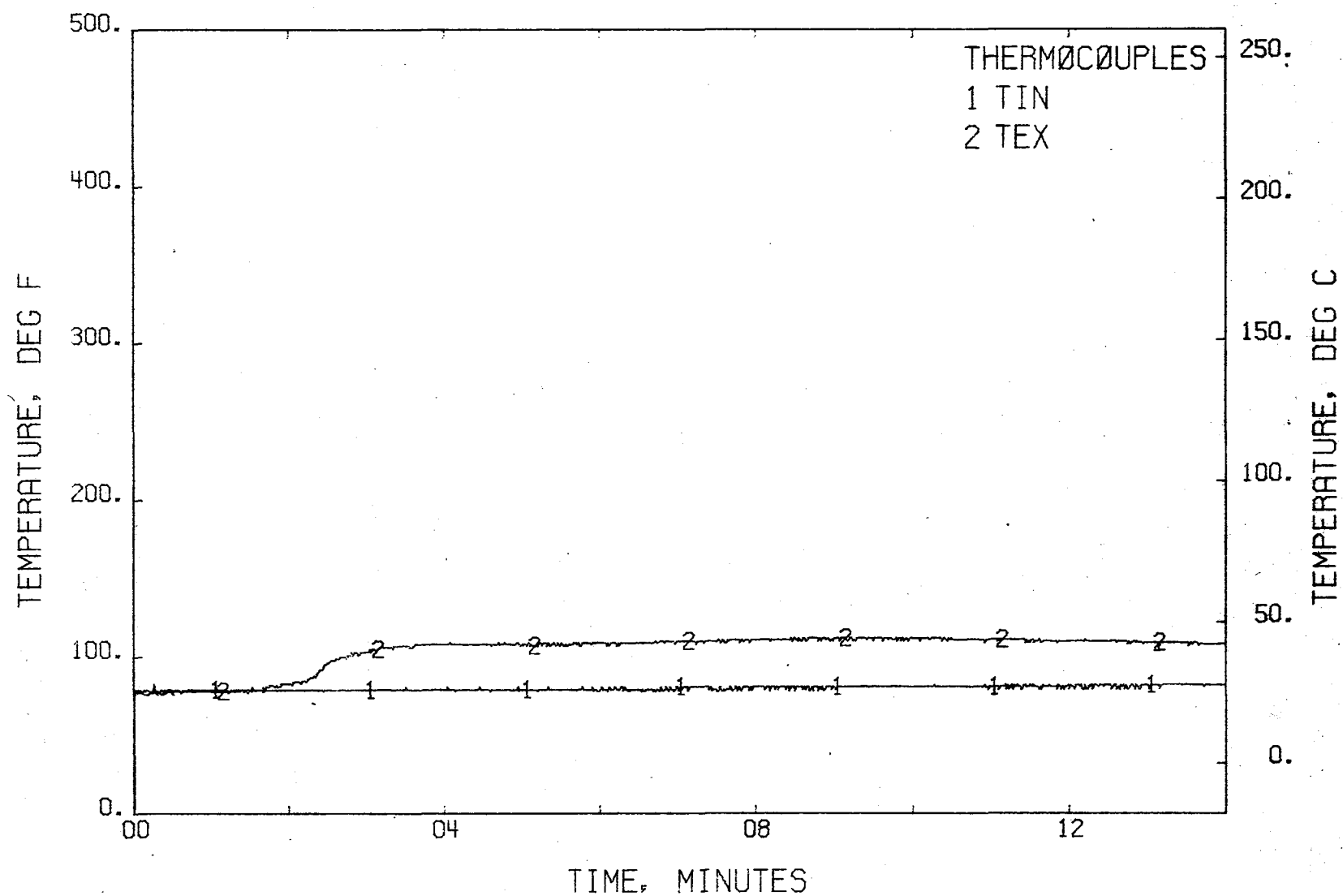


FIGURE 301 . - TEMPERATURES, INLET + EXIT  
TEST 16

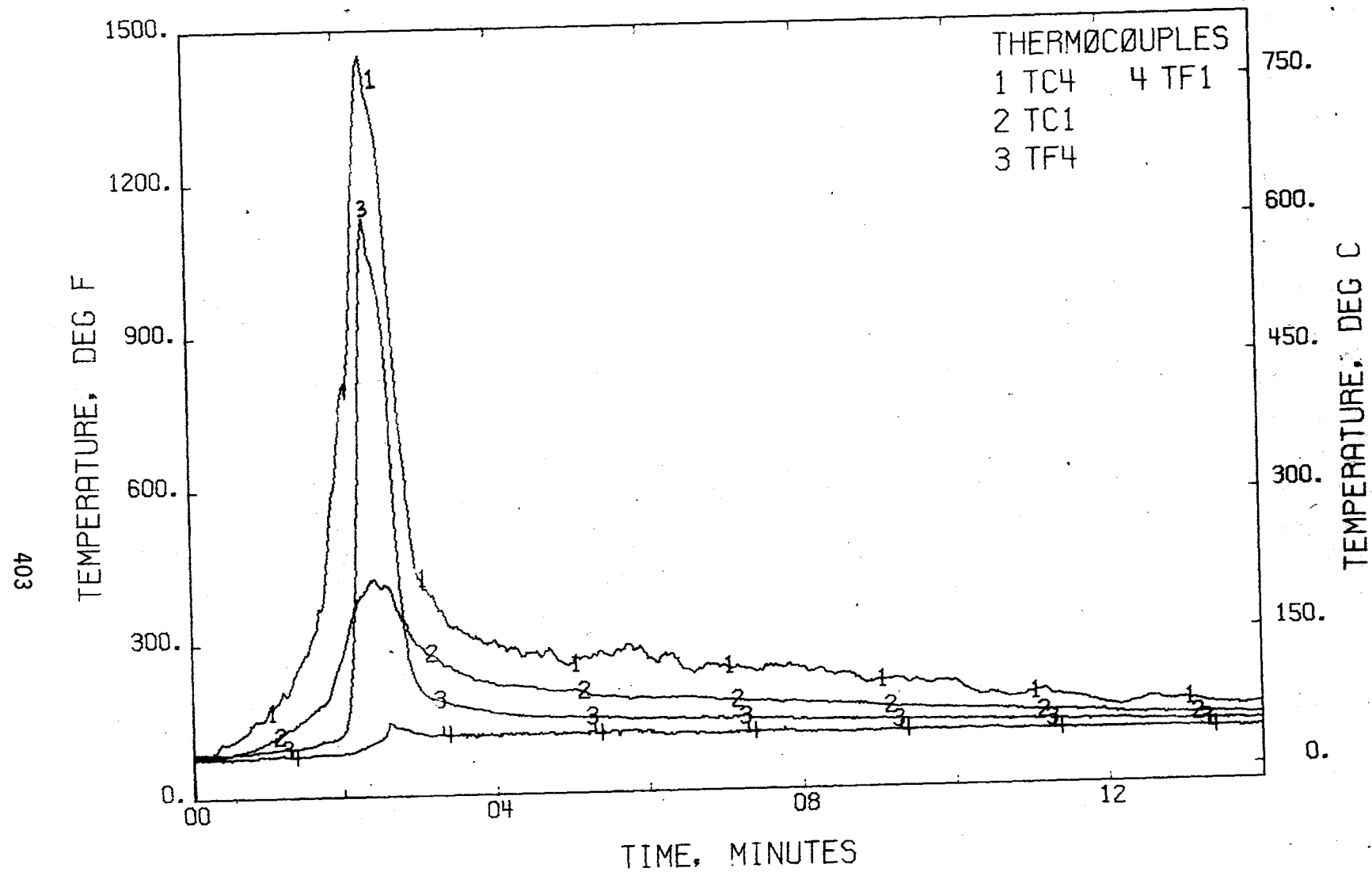


FIGURE 302 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 16

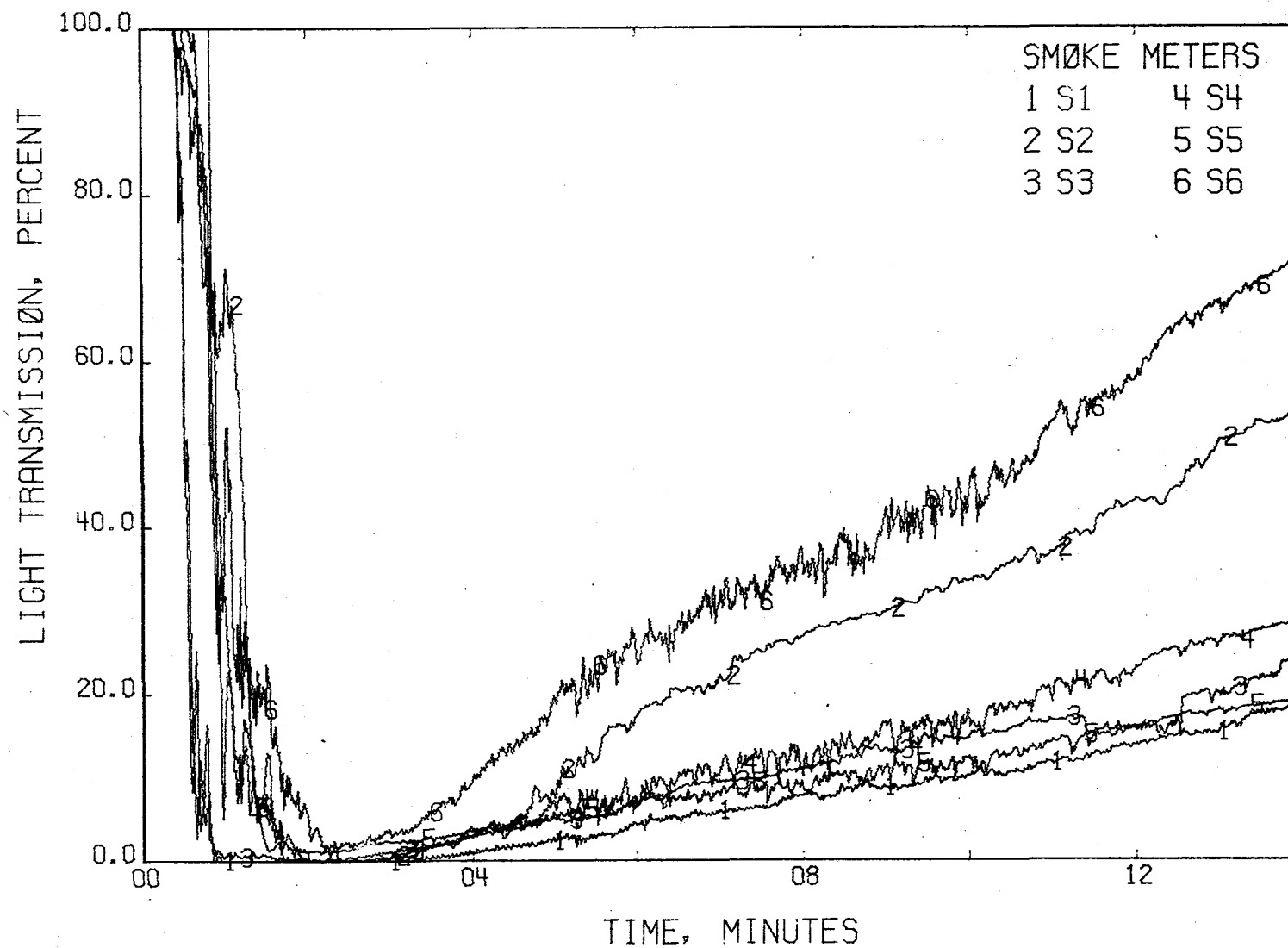


FIGURE 303 . - LIGHT TRANSMISSION  
TEST 16

405

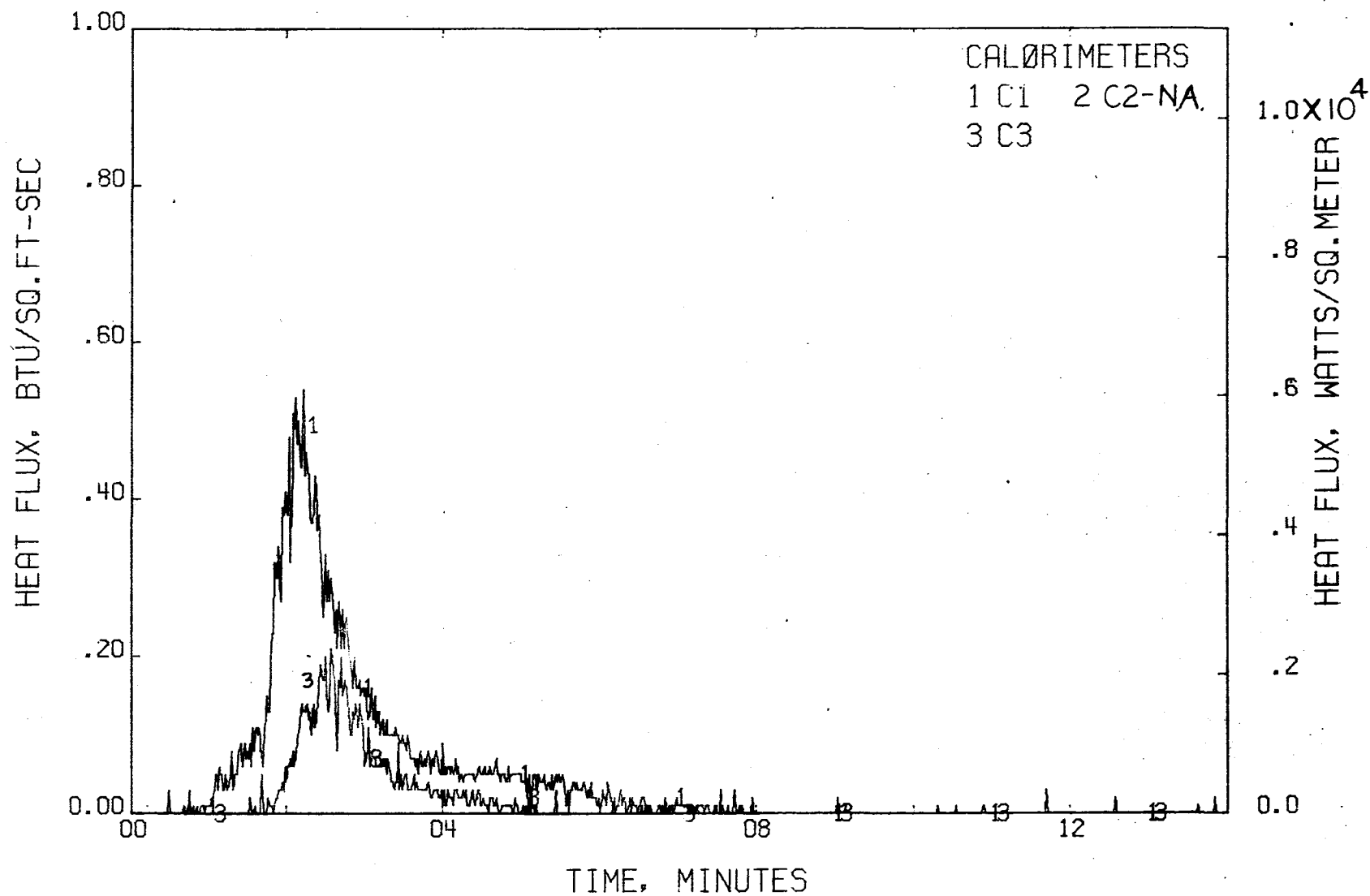


FIGURE 304 . - HEAT FLUX, AFT  
 TEST 16

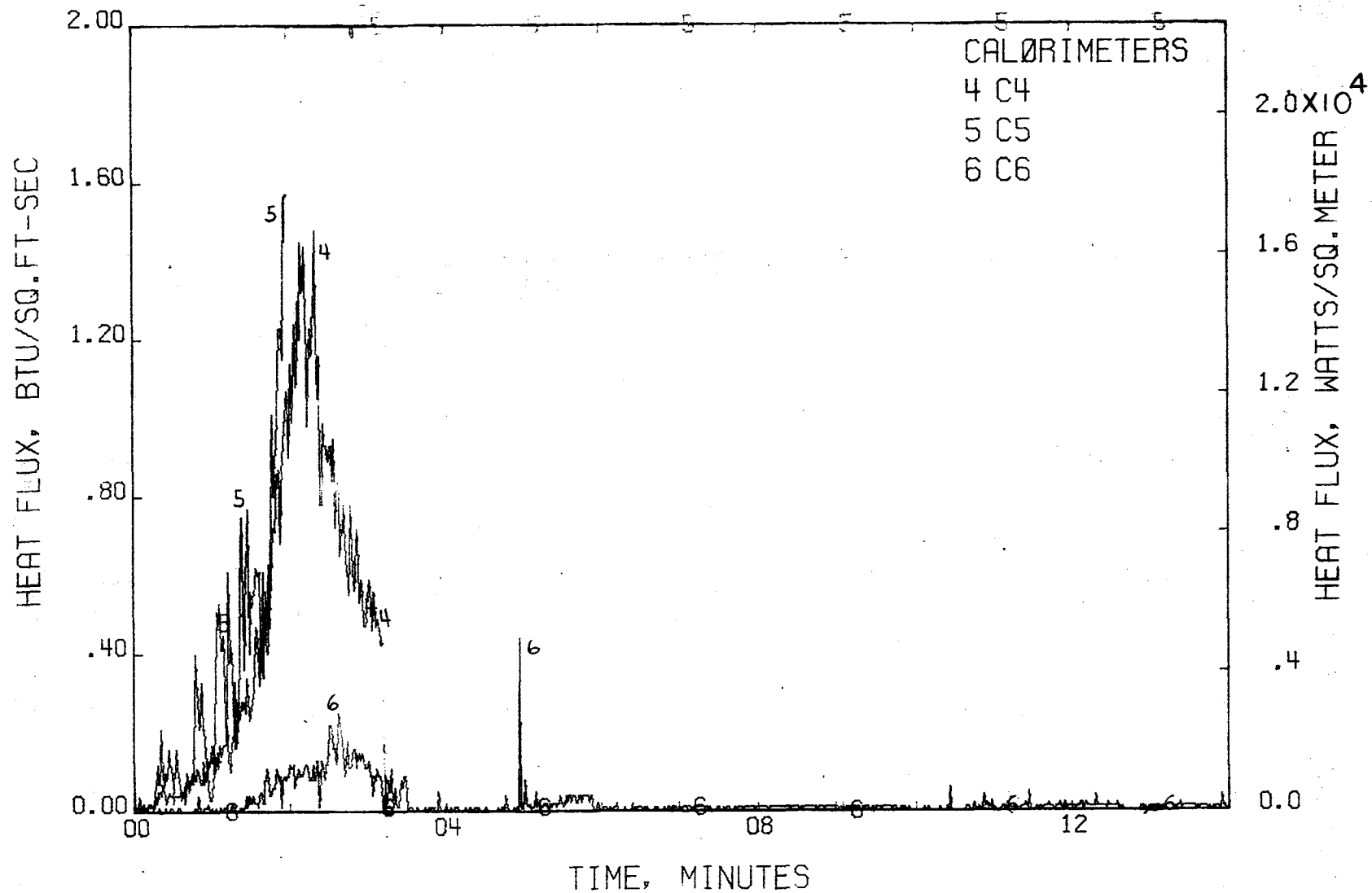


FIGURE 305 . - HEAT FLUX, MIDSECTION  
TEST 16

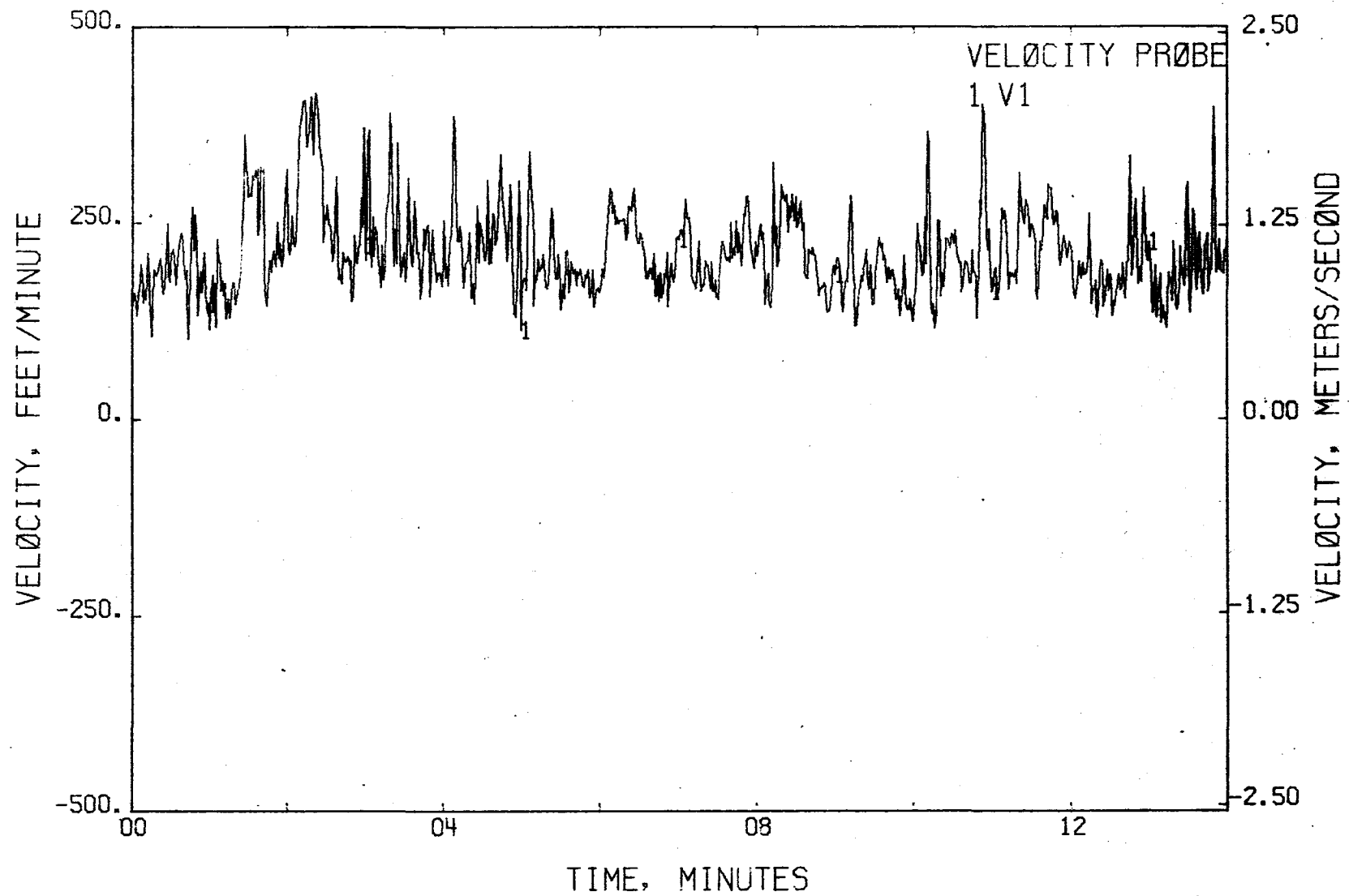


FIGURE 306 . - AIR VELOCITY  
TEST 16

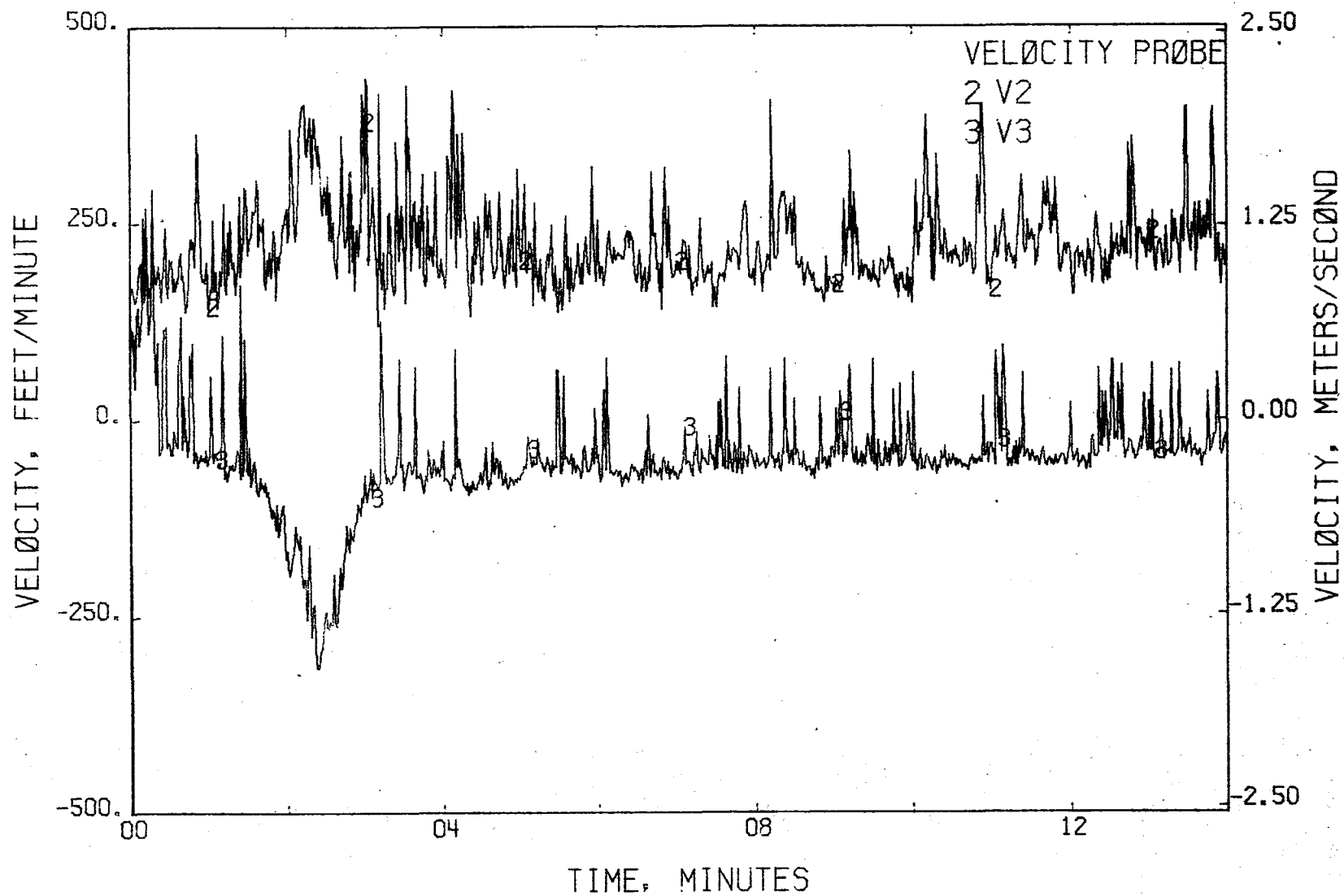


FIGURE 306 . - AIR VELOCITY - CONT.  
TEST 16



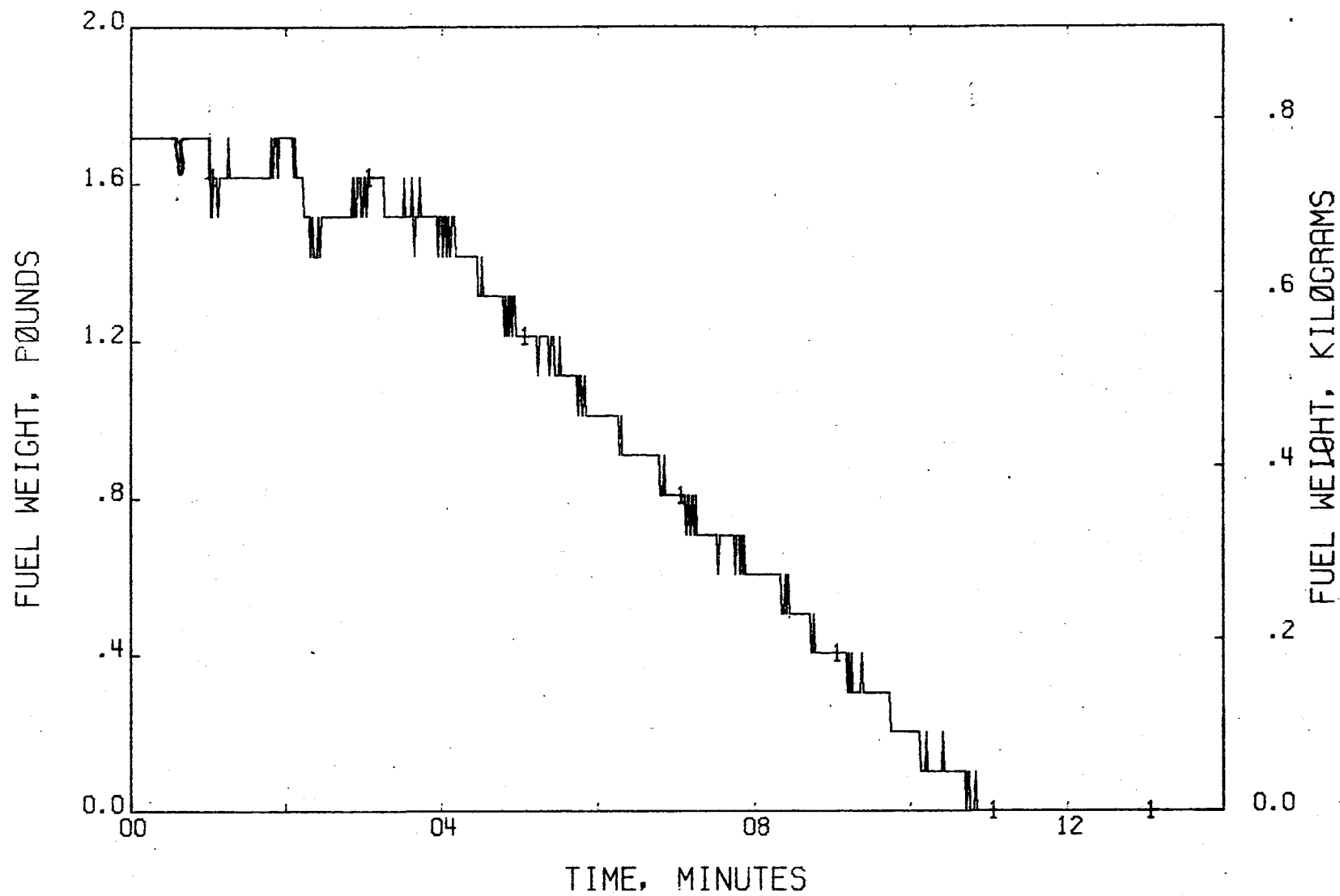


FIGURE 307 - FUEL WEIGHT LOSS  
TEST 16

410

SEAT WEIGHT, POUNDS

15.0  
12.0  
9.0  
6.0  
3.0  
0.0

00

04

08

12

TIMES, MINUTES

DATA NOT AVAILABLE

6.0  
4.5  
3.0  
1.5  
0.0

SEAT WEIGHT, KILOGRAMS

SEAT WEIGHT LOSS  
TEST 16

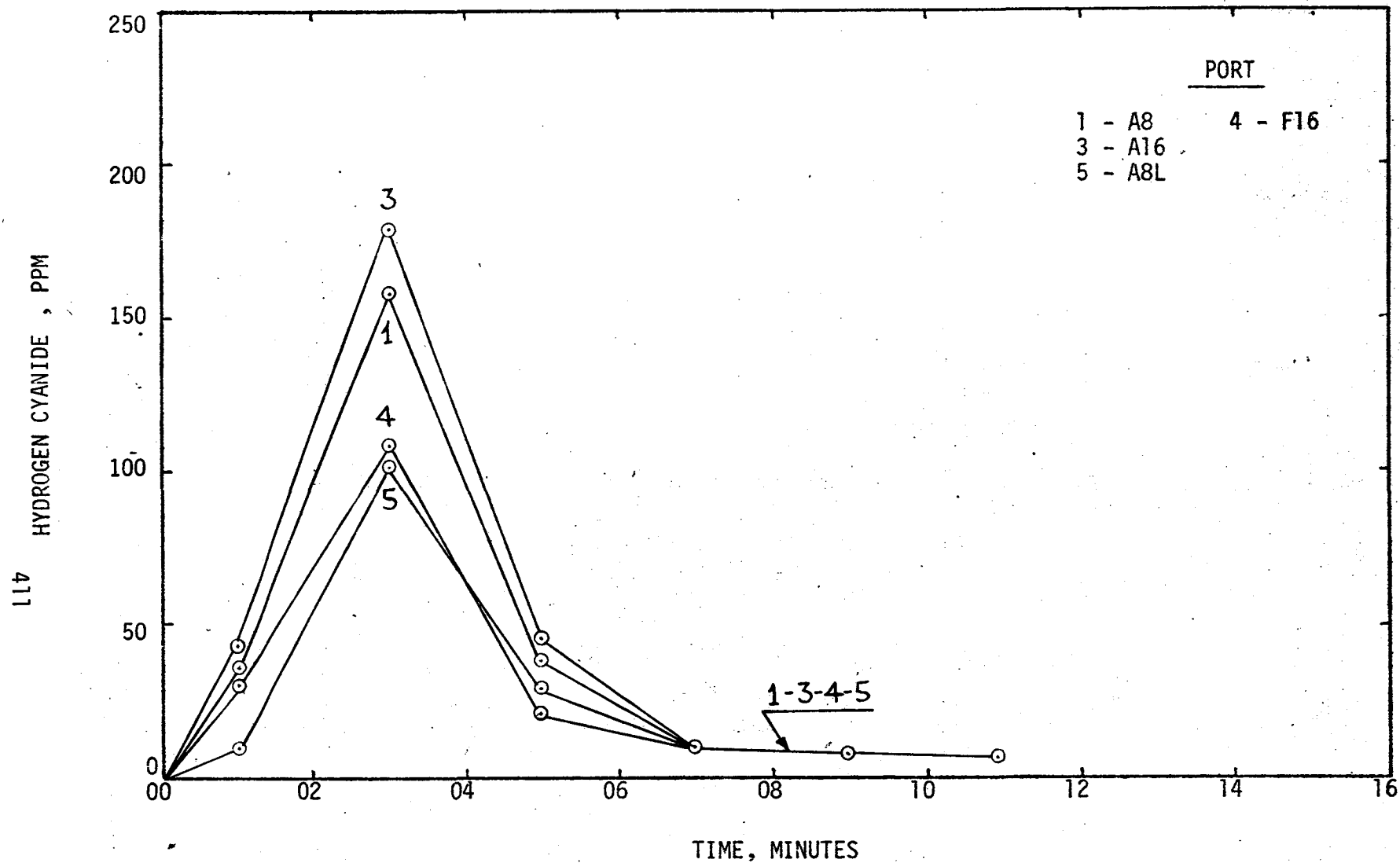


FIGURE 308 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 16

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 3 PPM

HYDROGEN CHLORIDE - < 6 PPM

FIGURE 309 . - HYDROGEN FLUORIDE AND CHLORIDE CONCENTRATIONS  
TEST 16

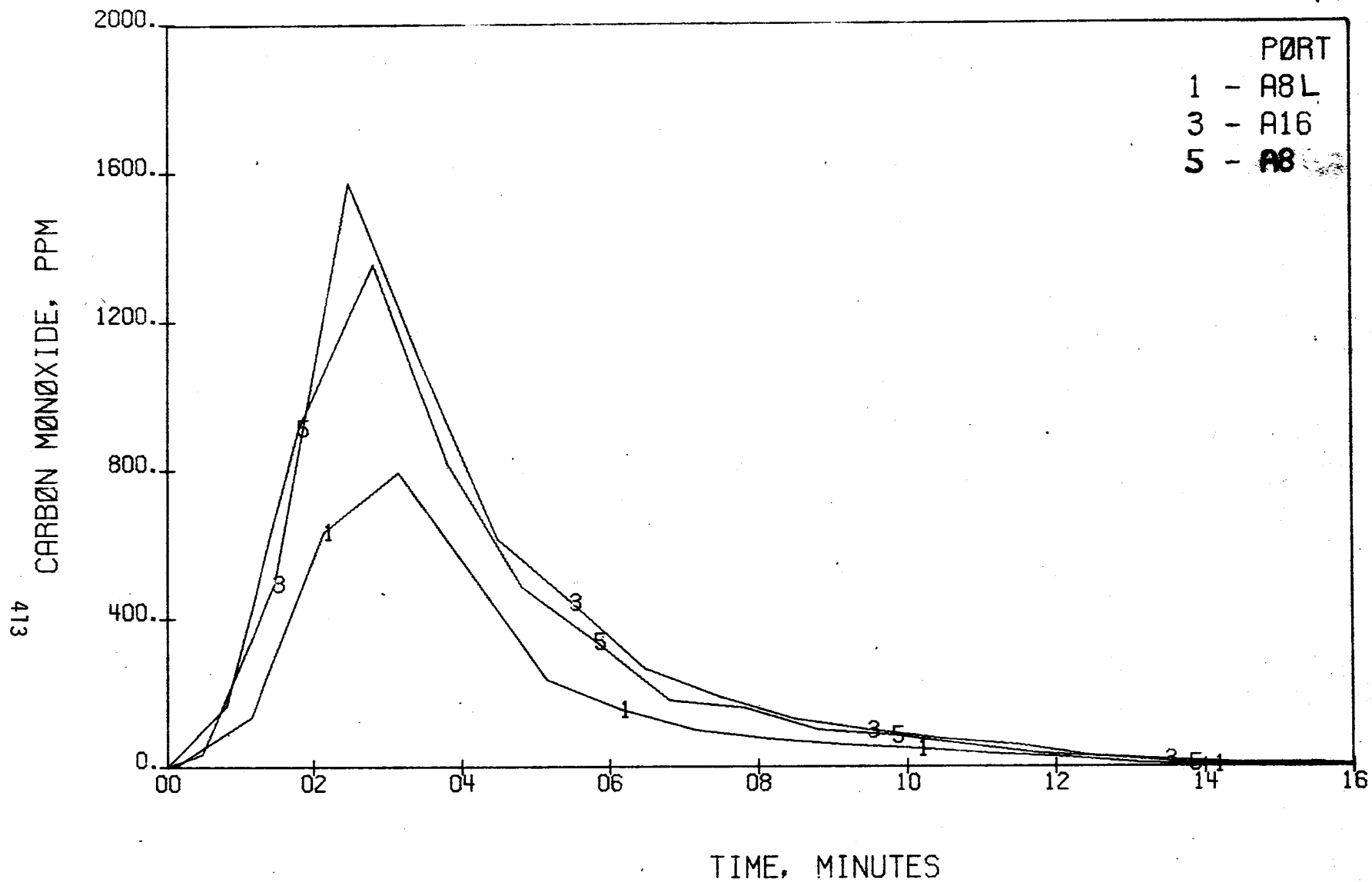


FIGURE 310 . - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 16

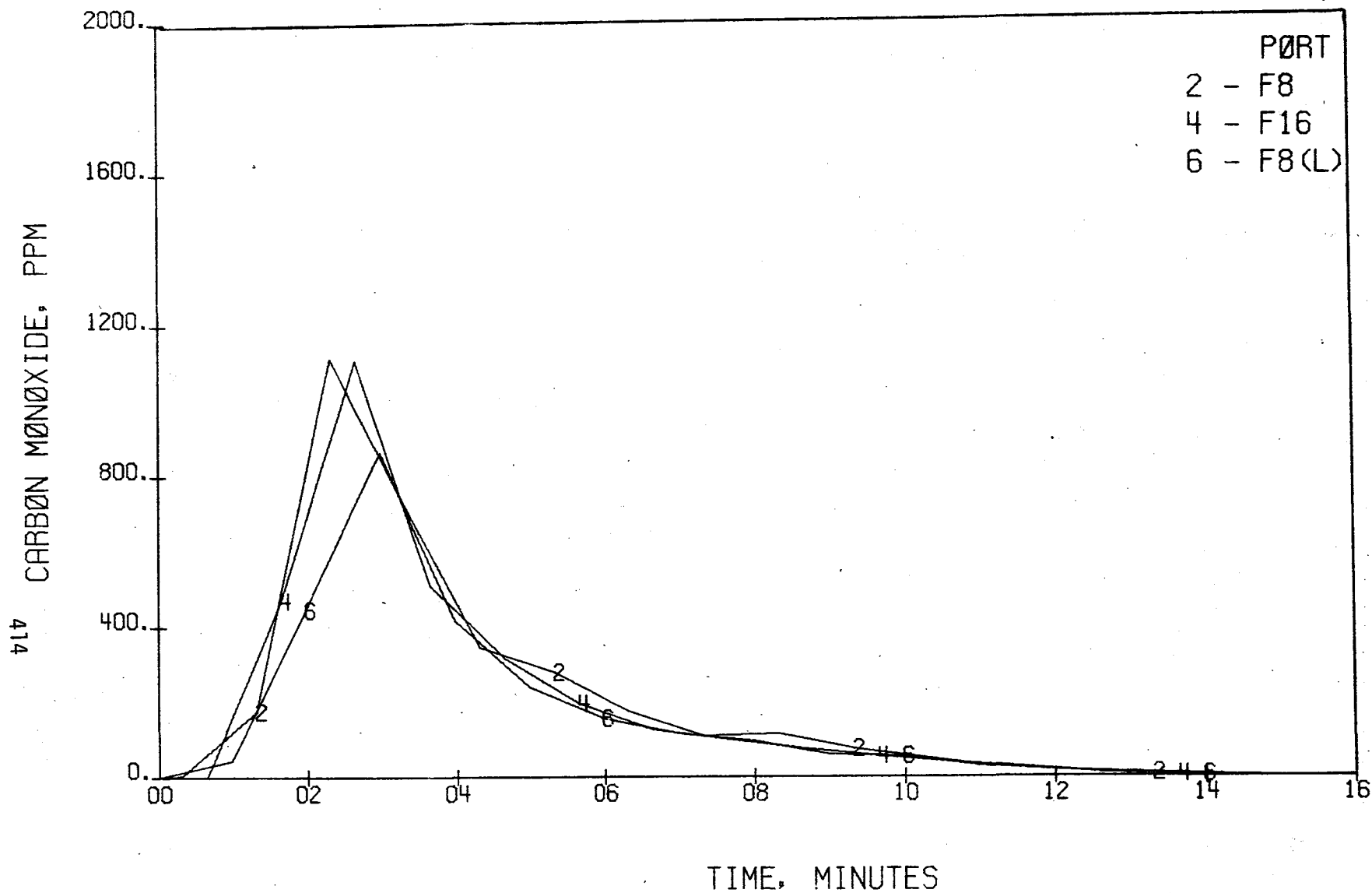


FIGURE 311 - CARBON MONOXIDE CONCENTRATIONS, FØRE  
TEST 16

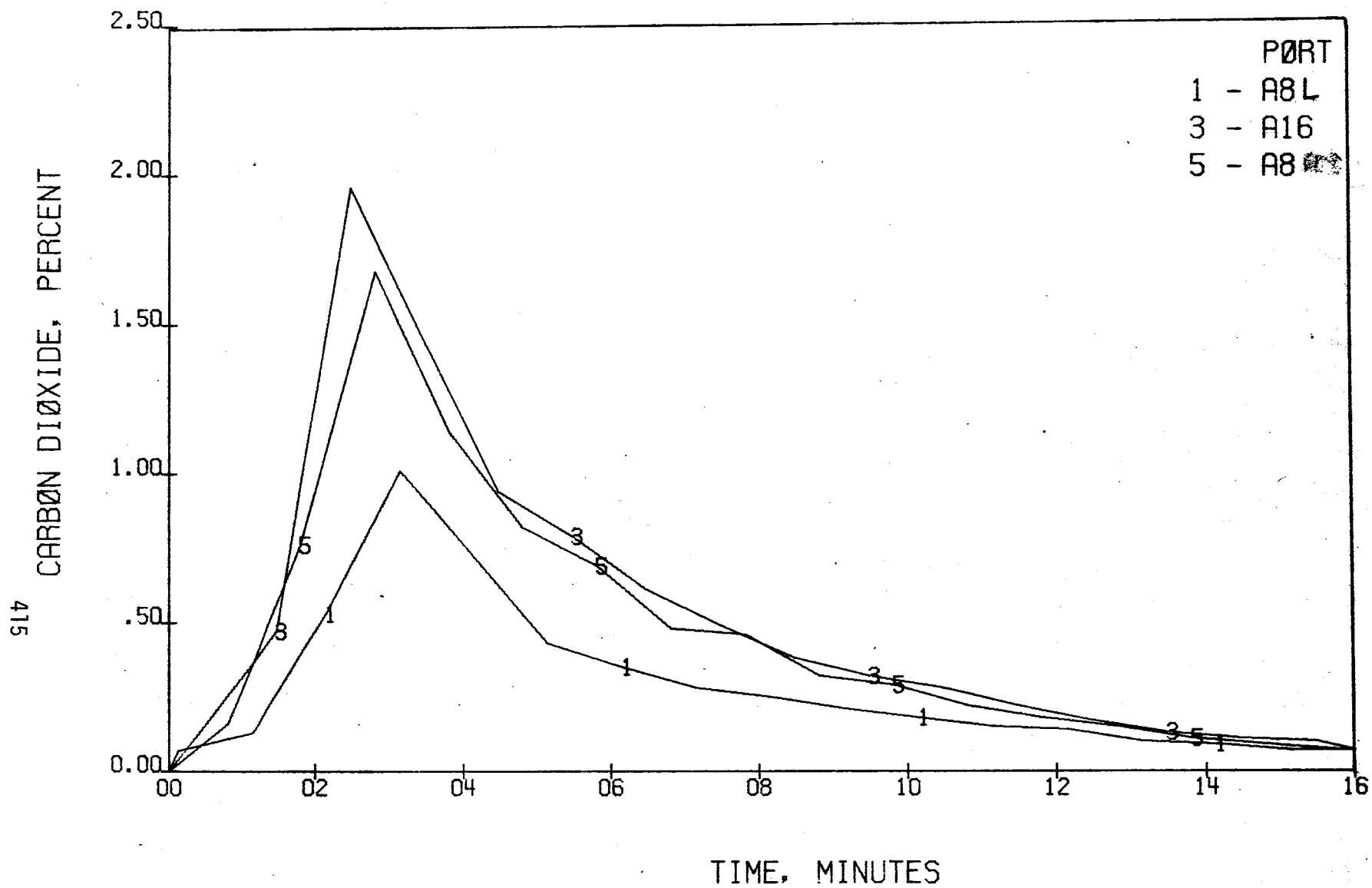


FIGURE 312 .- CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 16

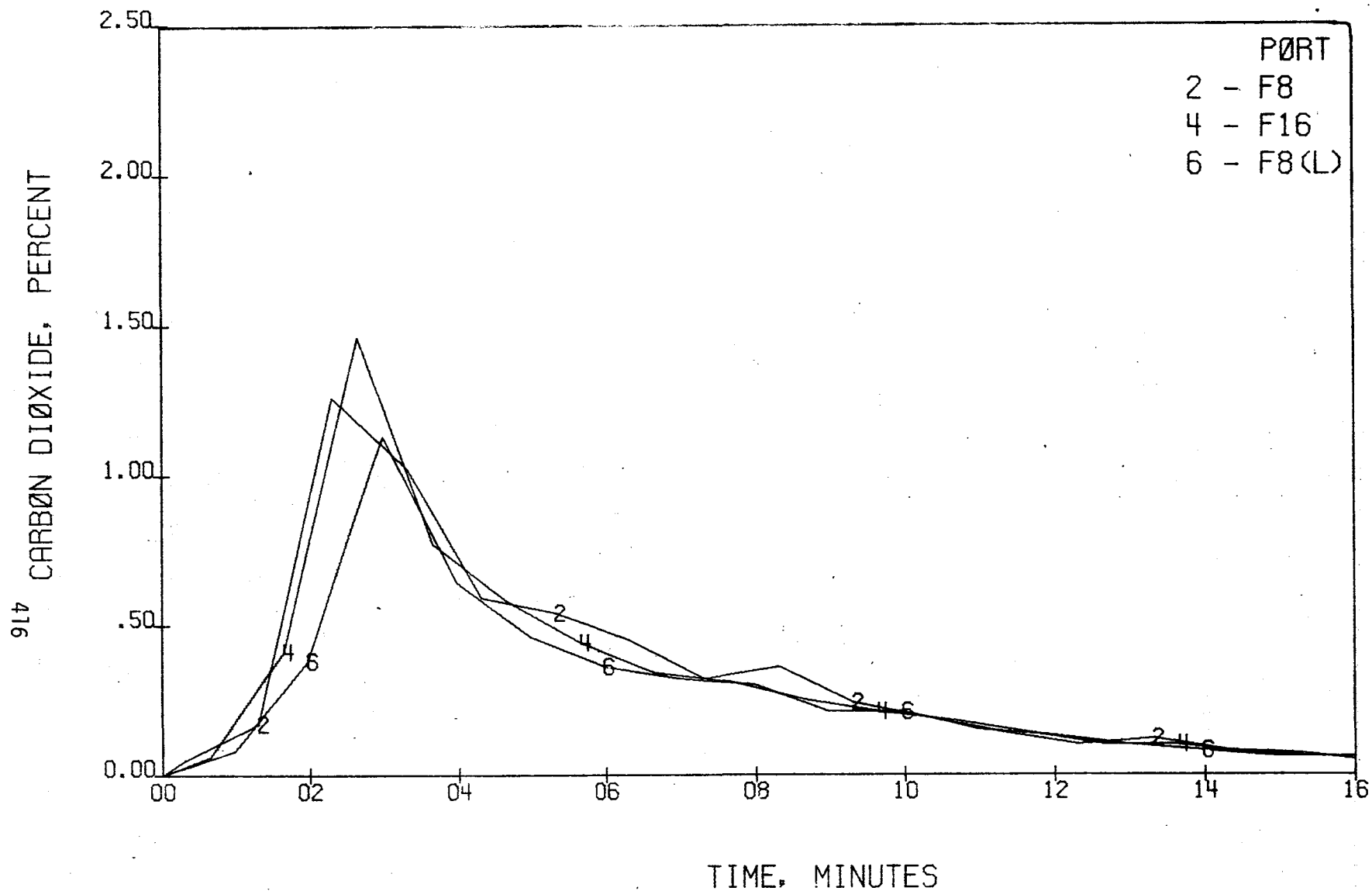


FIGURE 313 . - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 16



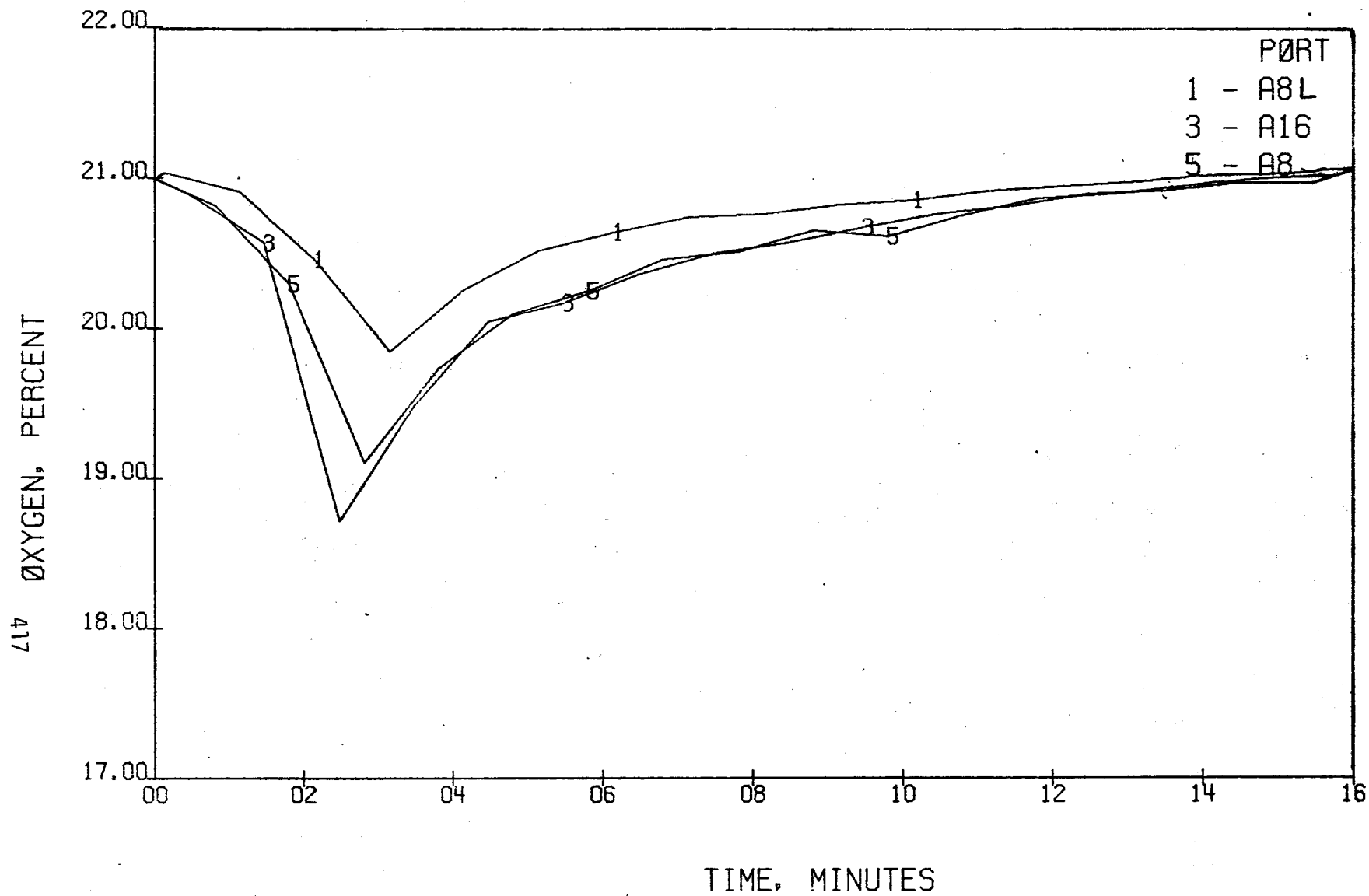


FIGURE 314 . - OXYGEN CONCENTRATIONS, AFT  
TEST 16

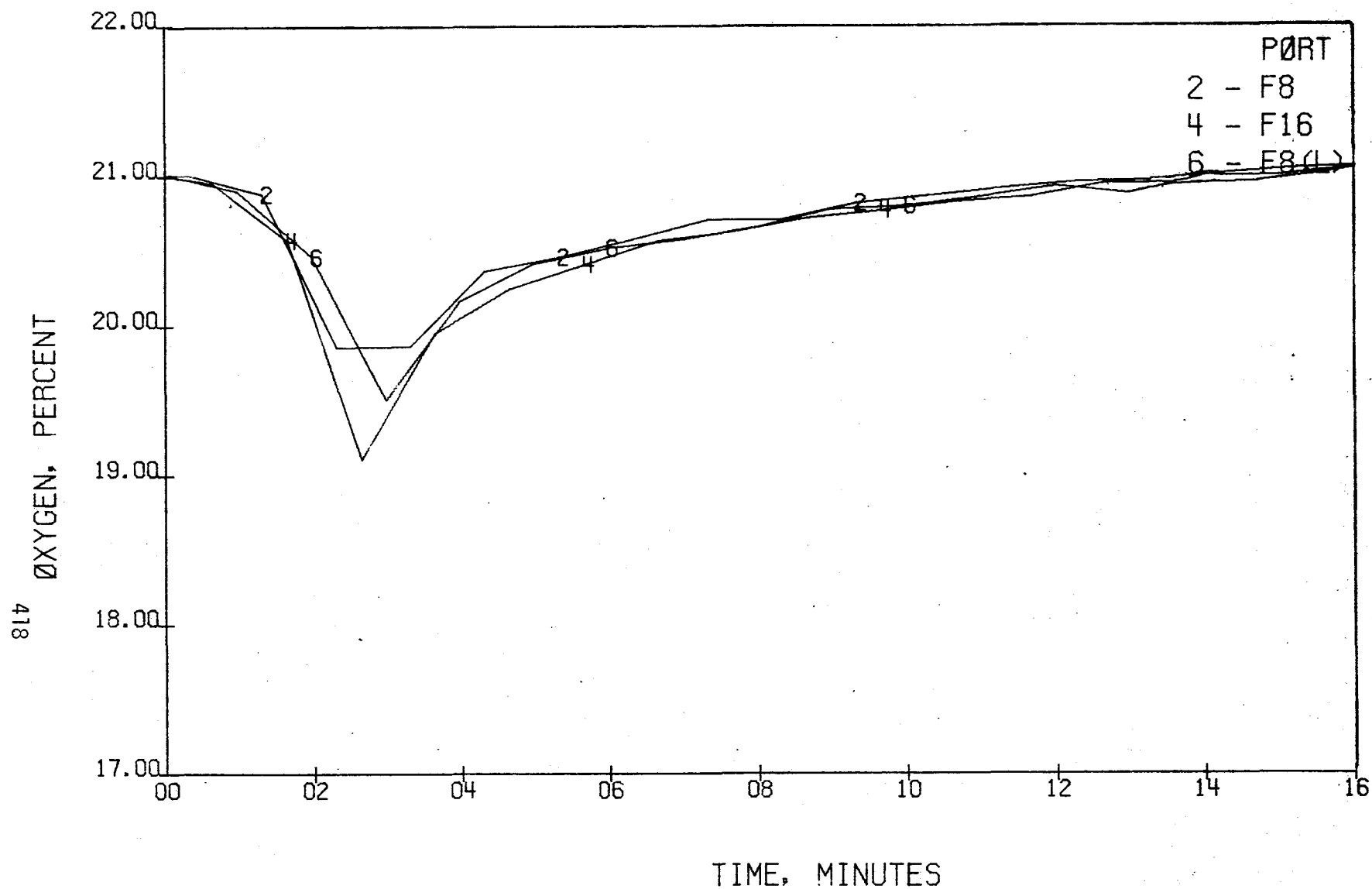


FIGURE 315 - OXYGEN CONCENTRATIONS, FØRE  
TEST 16

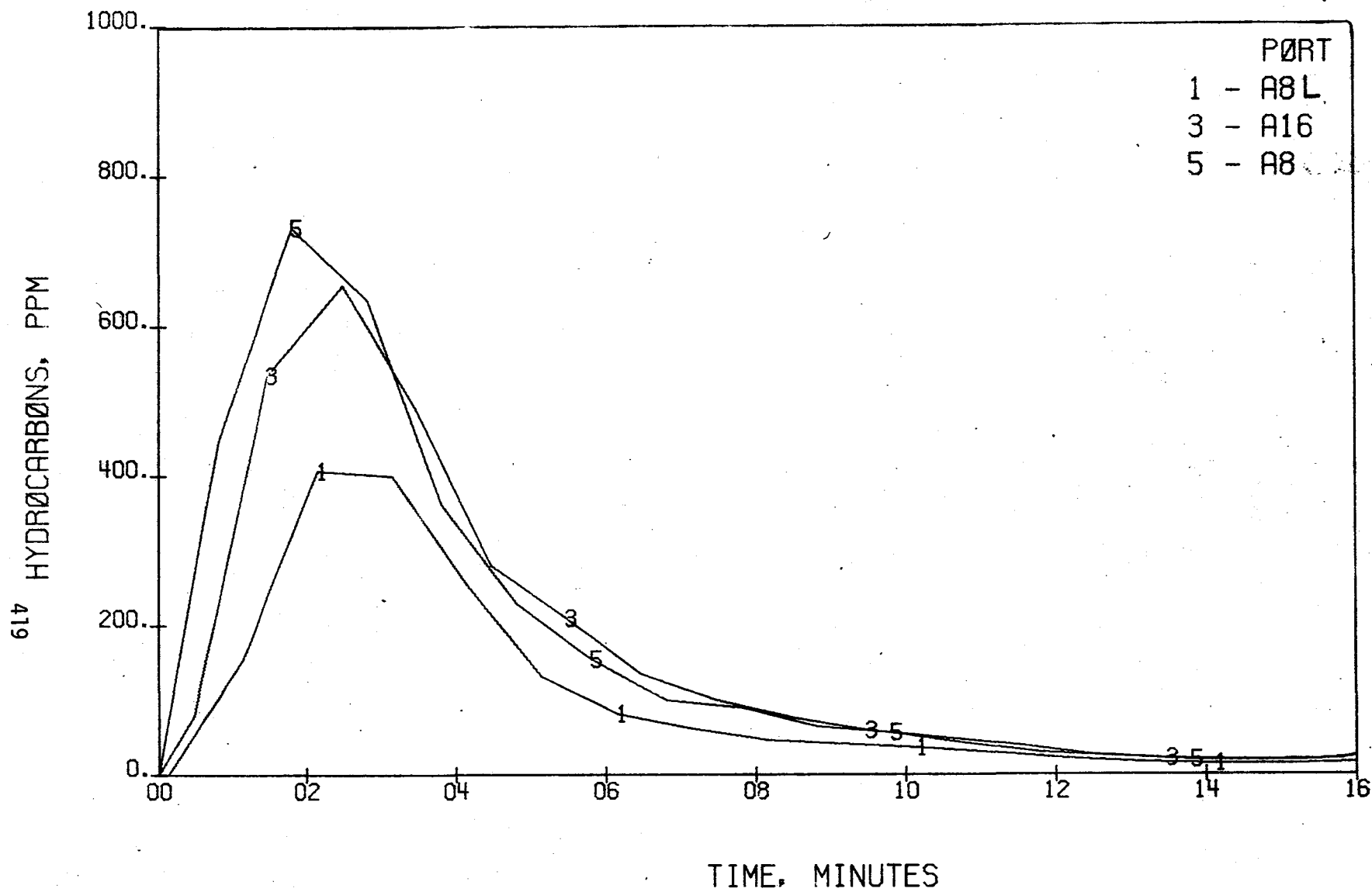


FIGURE 316 - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 16

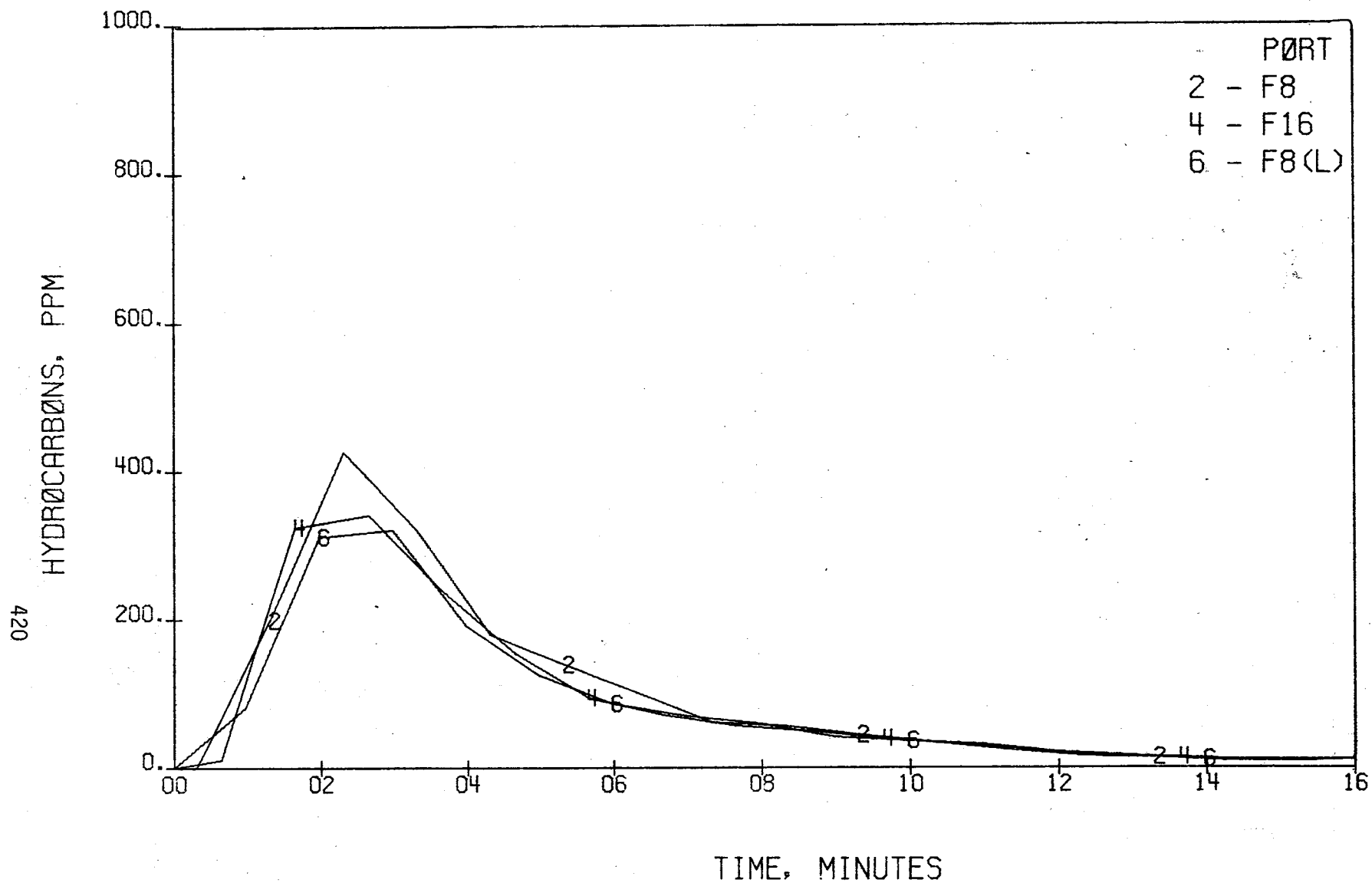


FIGURE 317 .- HYDROCARBONS CONCENTRATIONS, FØRE TEST 16

TEST 17

---

COVERED URETHANE FOAM SEATS

TEST 17

COVERED URETHANE FOAM SEATS

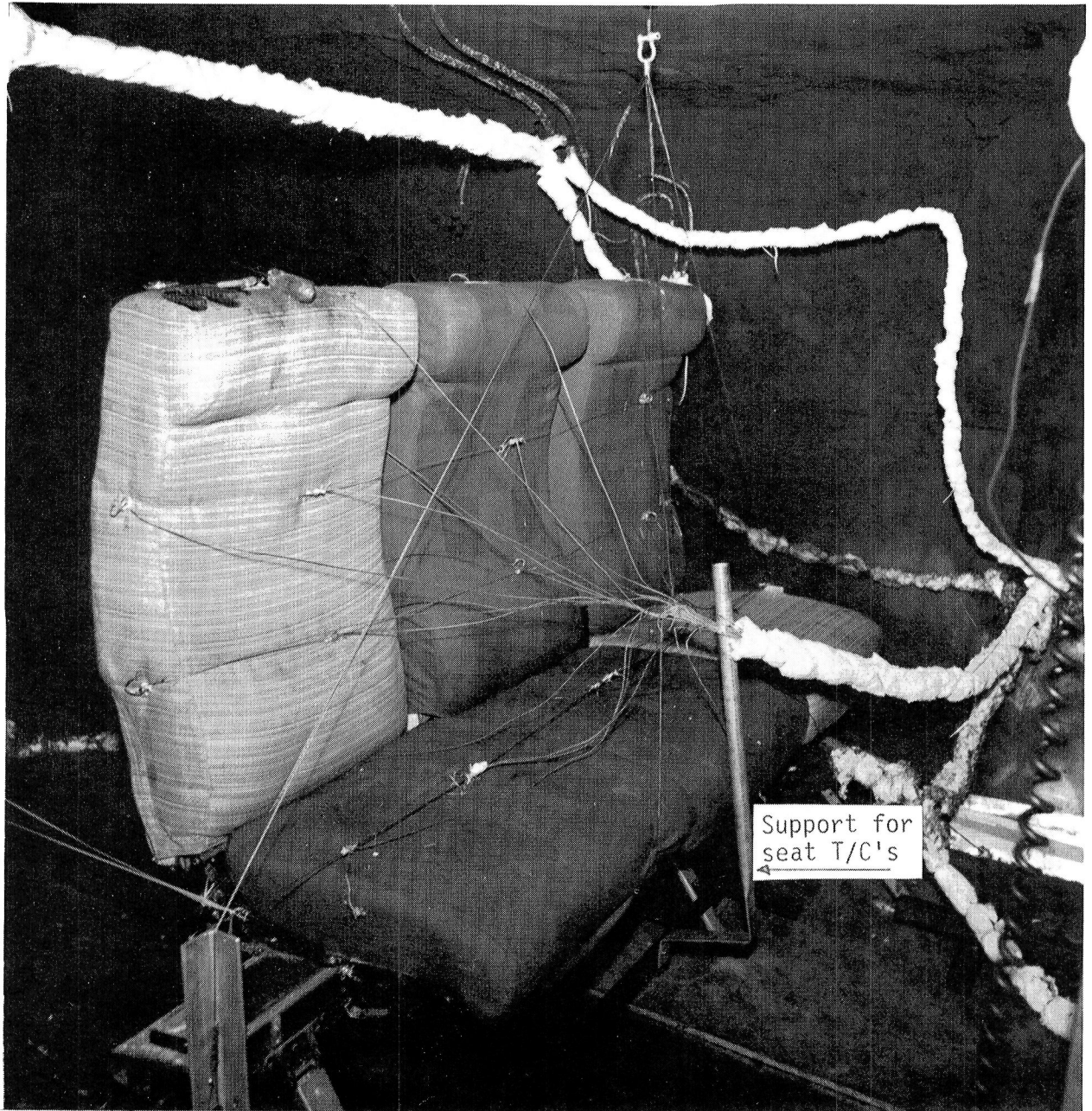


FIGURE 318. - PRE-TEST CONFIGURATION(FRONT VIEW), TEST 17



FIGURE 319. - POST-TEST CONFIGURATION (FRONT VIEW), TEST 17





FIGURE 320 . - PRE-TEST CONFIGURATION(REAR VIEW), TEST 17





FIGURE 321 . - POST-TEST CONFIGURATION ( REAR VIEW), TEST 17

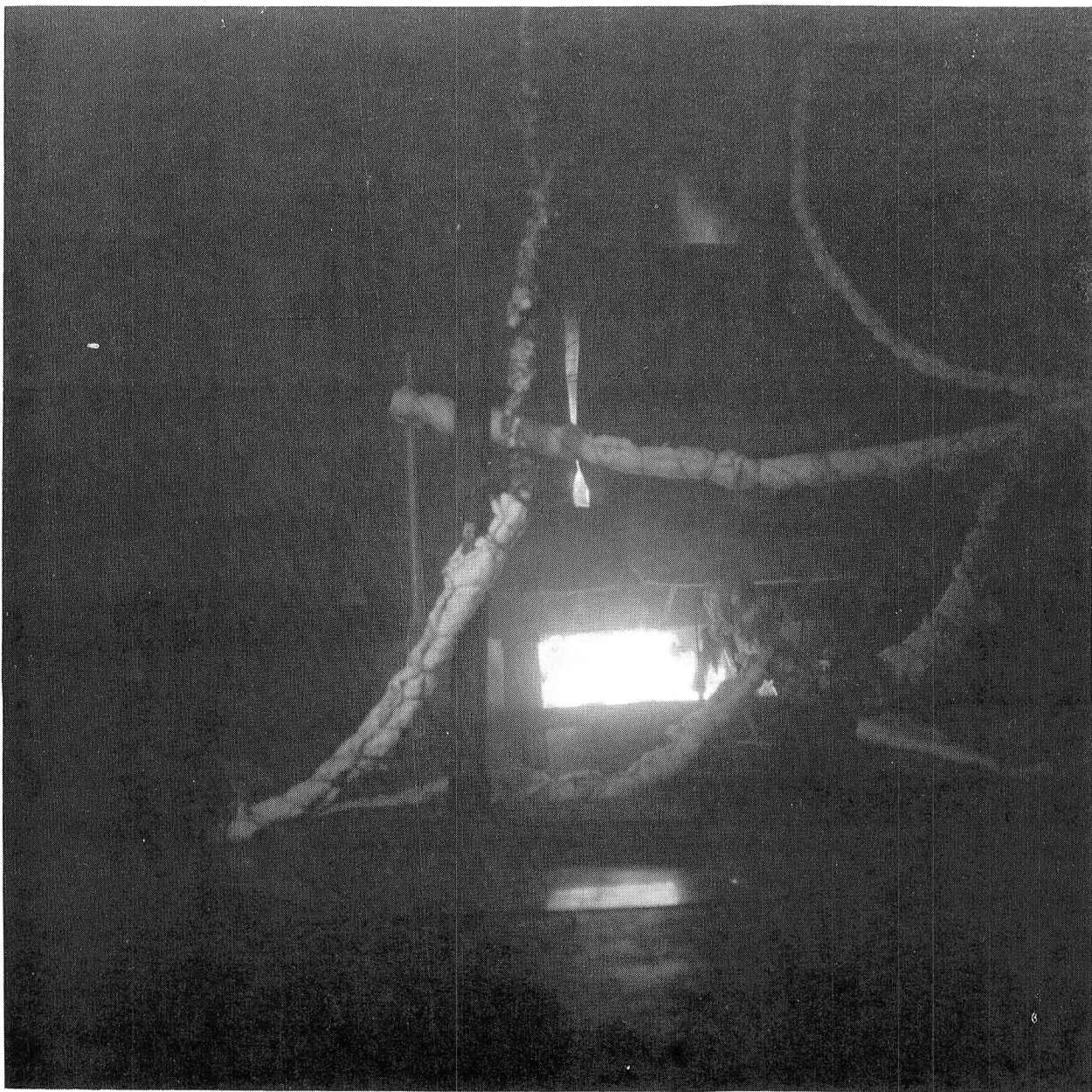


FIGURE 322 . - FIRE DURING TEST 17

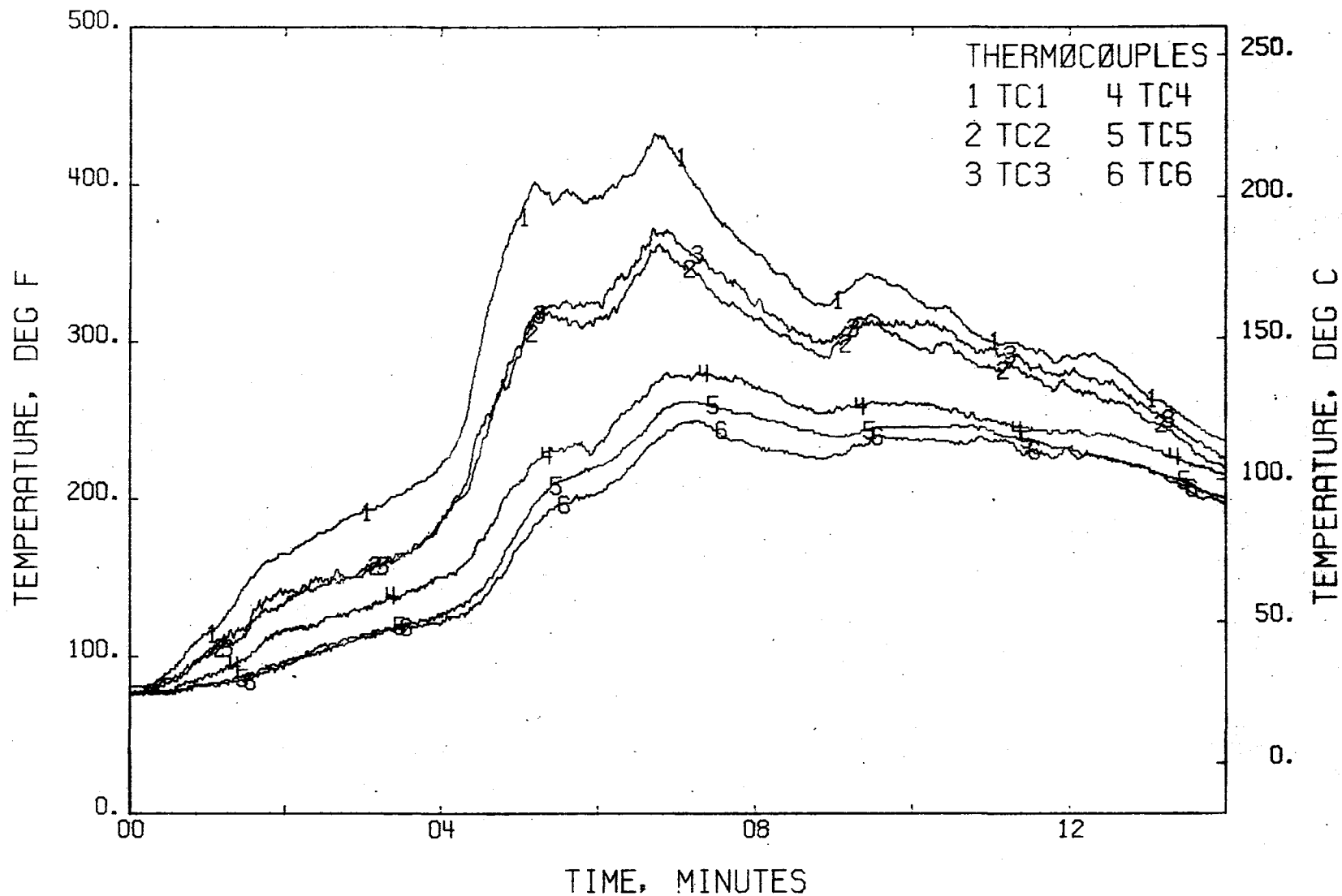
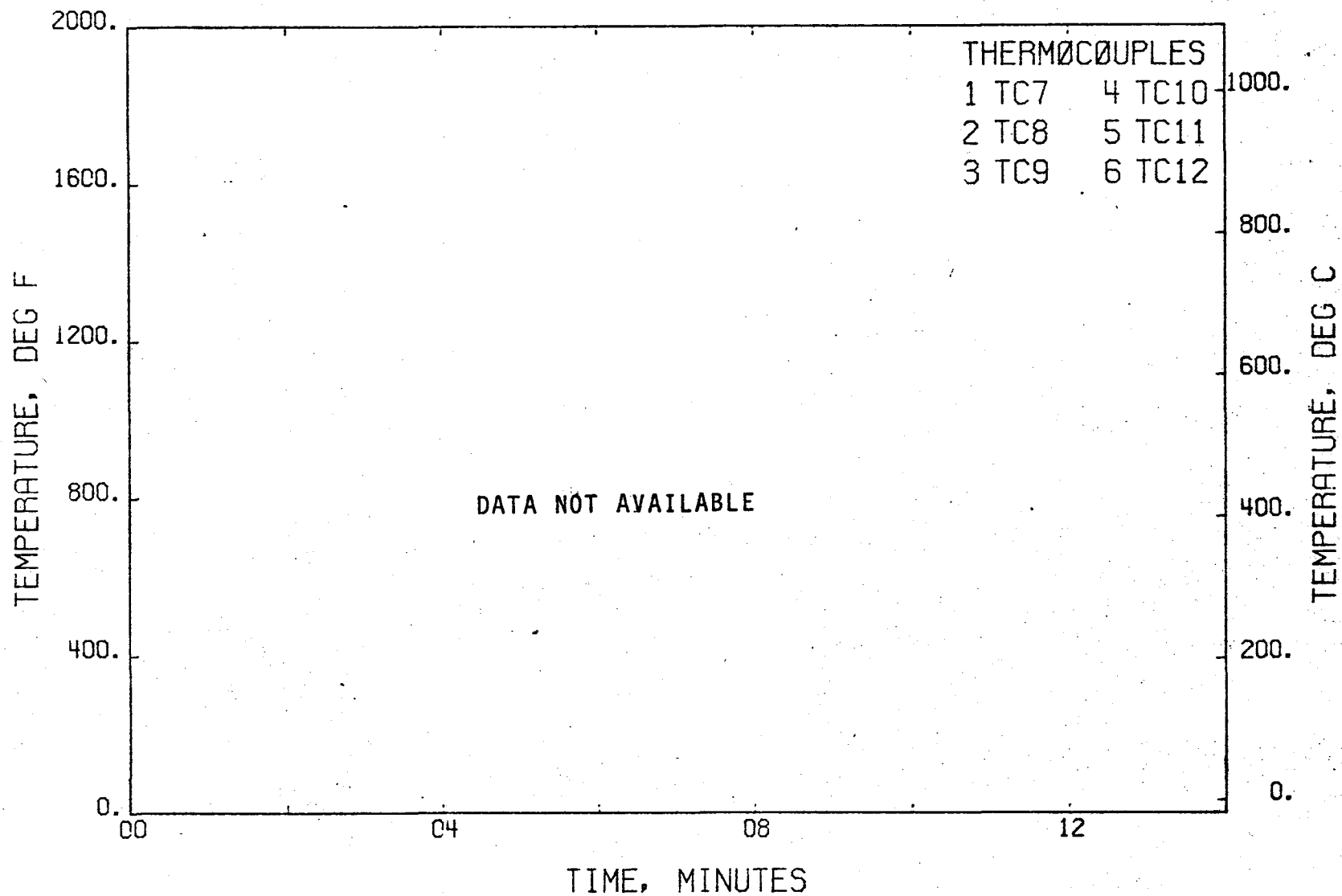


FIGURE 323 . - TEMPERATURES, T/C TREE 1  
TEST 17

428



TEMPERATURES, T/C TREE 2  
TEST 17

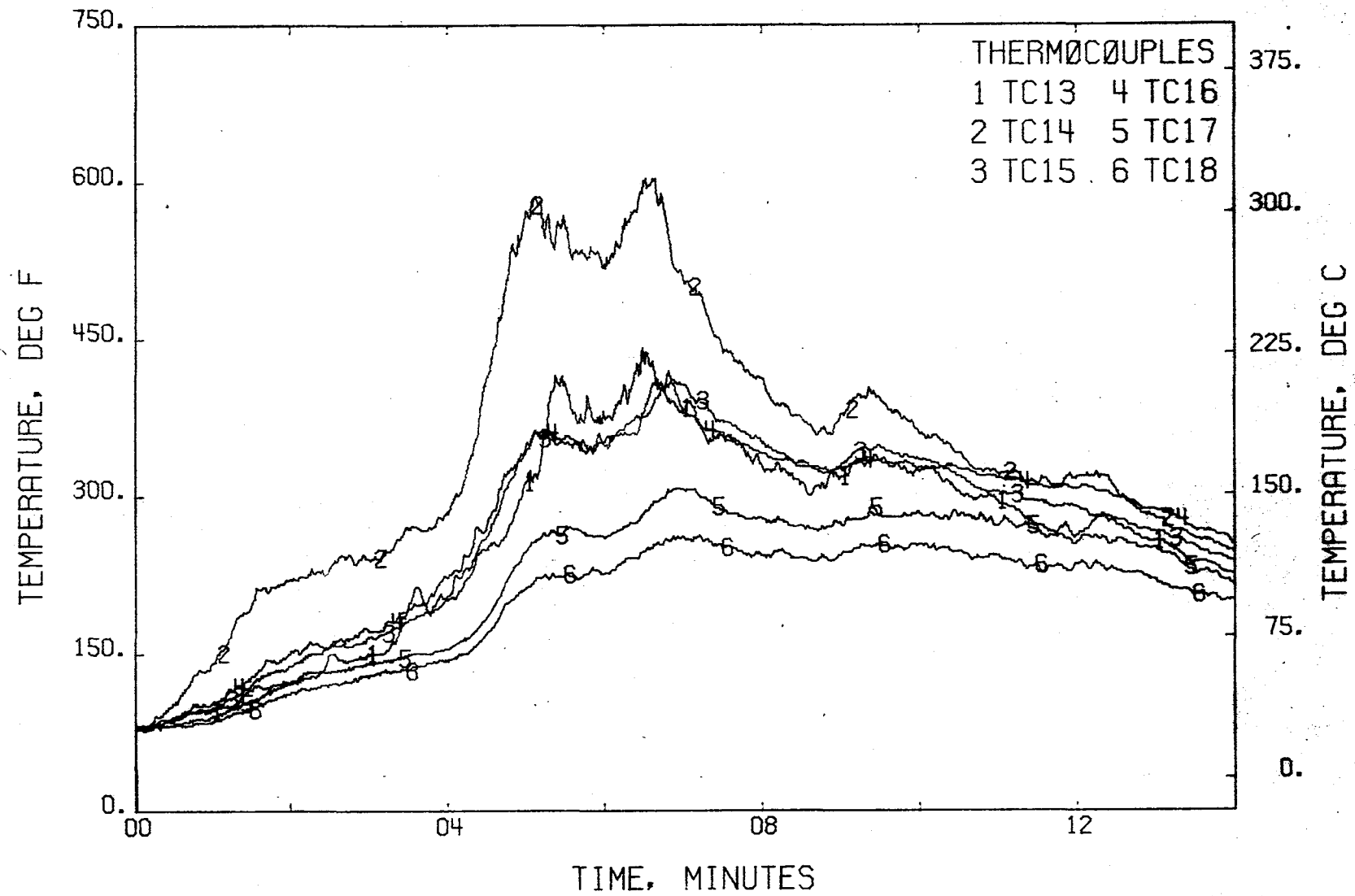


FIGURE 324 . - TEMPERATURES, T/C TREE 3  
TEST 17

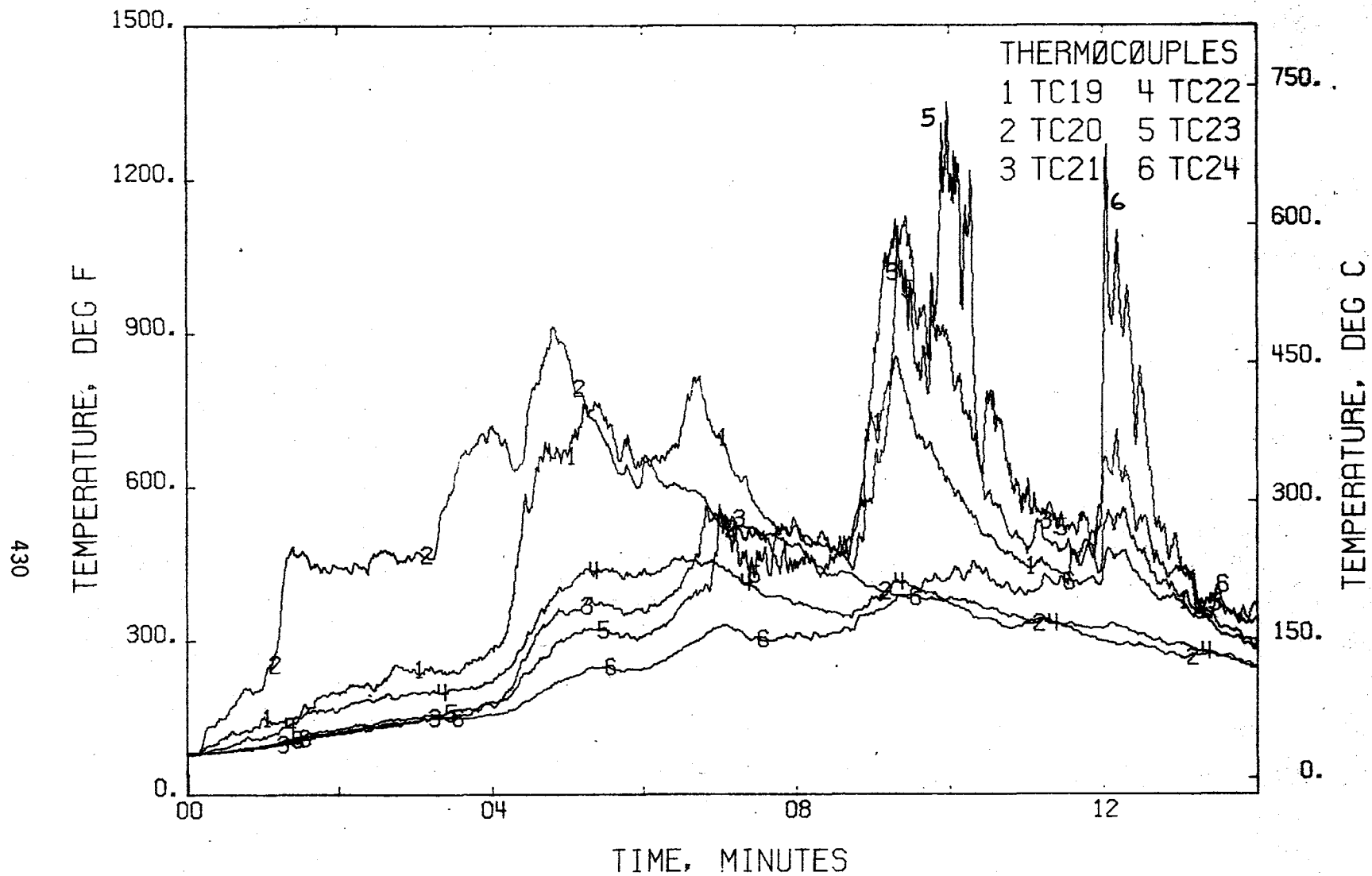


FIGURE 325 . - TEMPERATURES, T/C TREE 4  
TEST 17

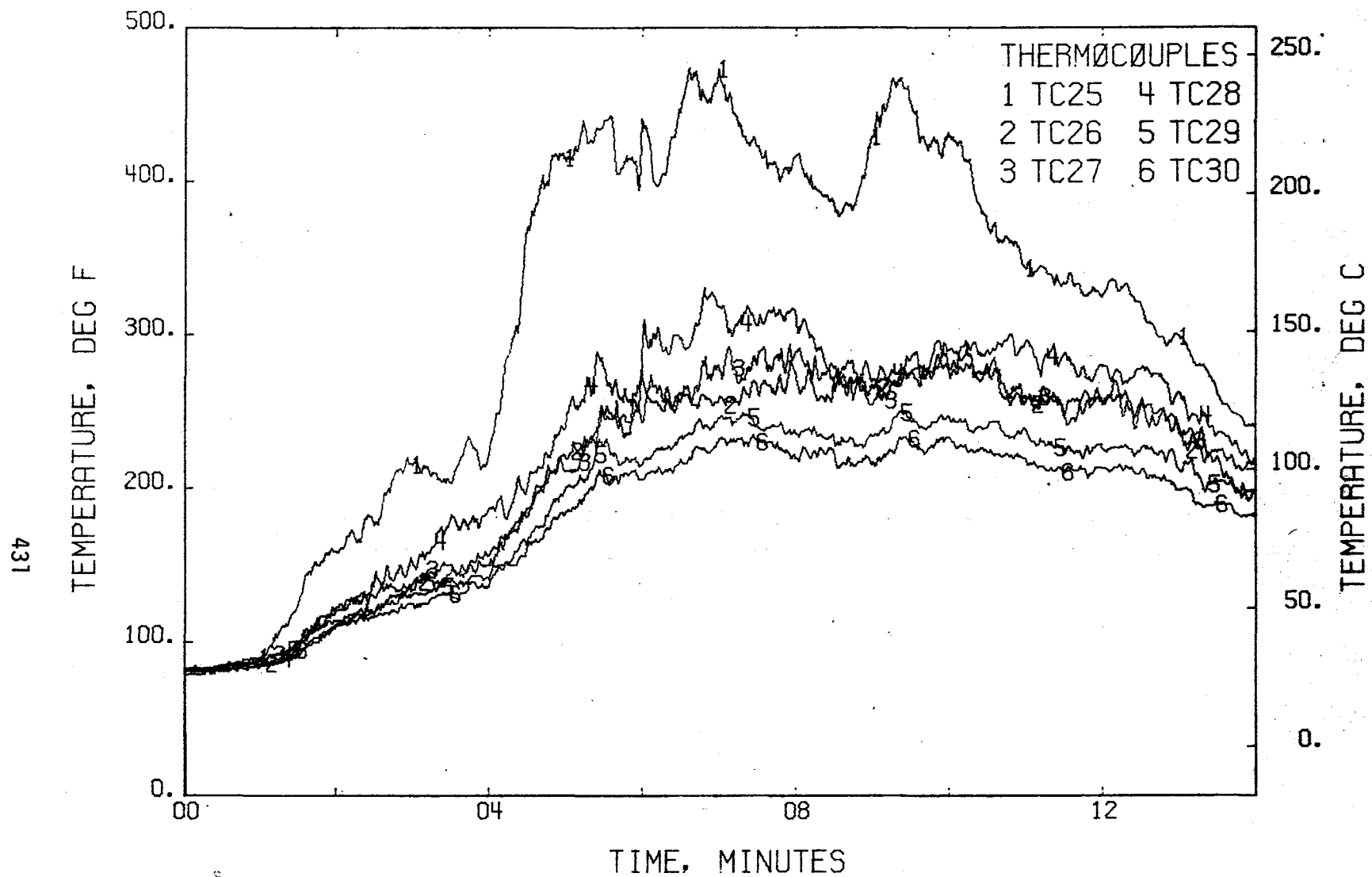
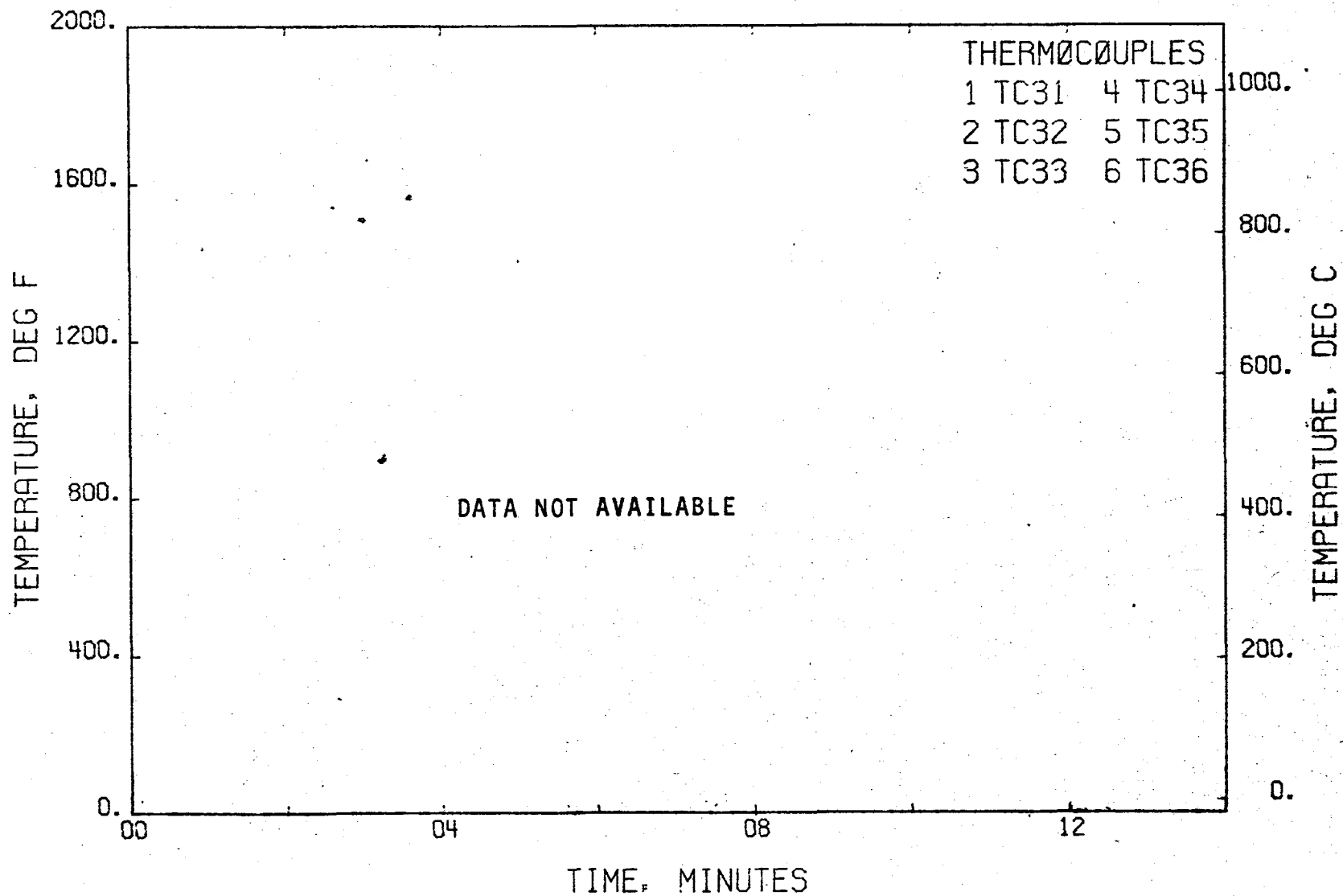


FIGURE 326 . - TEMPERATURES, T/C TREE 5  
TEST 17

432



TEMPERATURES, T/C TREE 6  
TEST 17



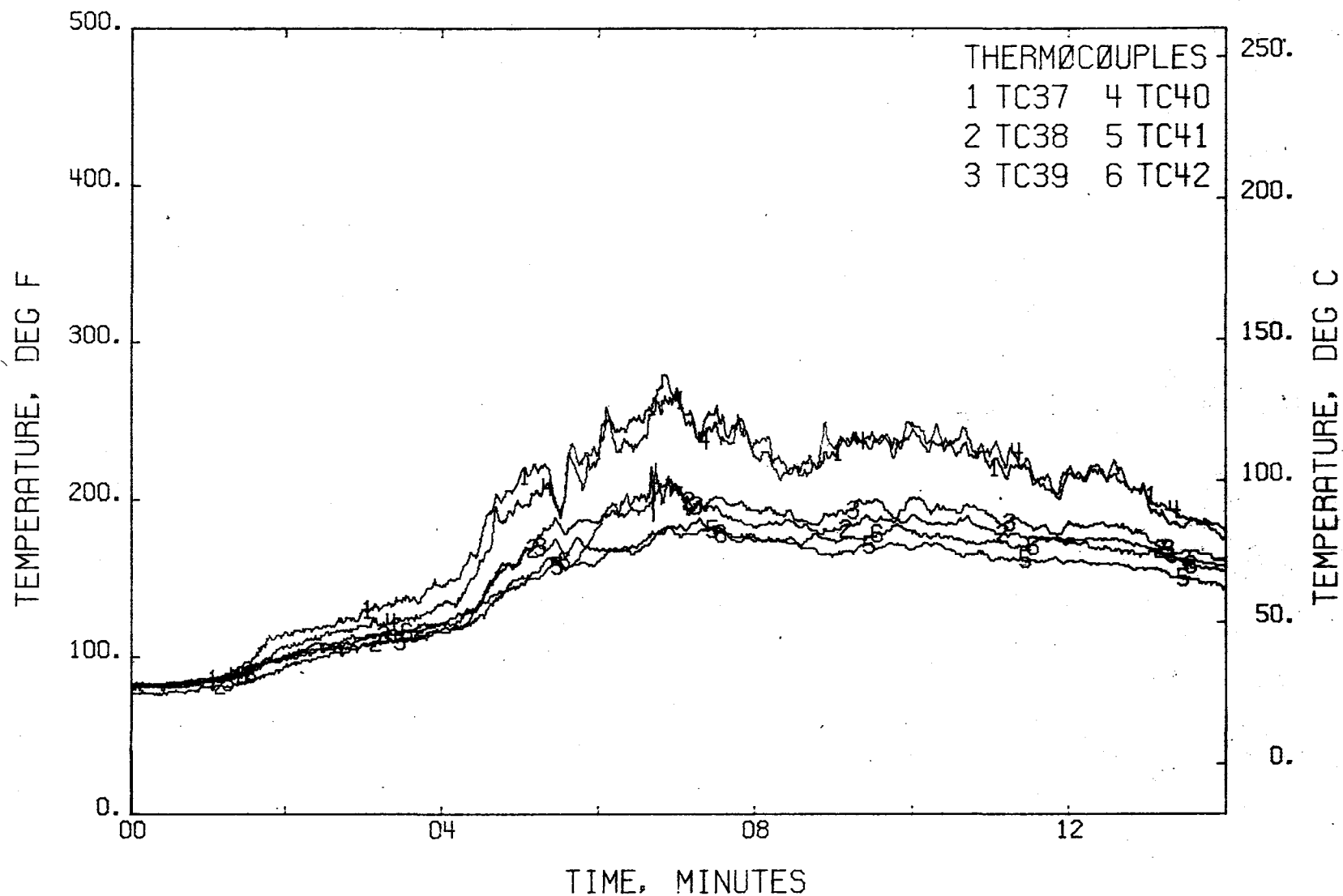


FIGURE 327 . - TEMPERATURES, T/C TREE 7  
TEST 17

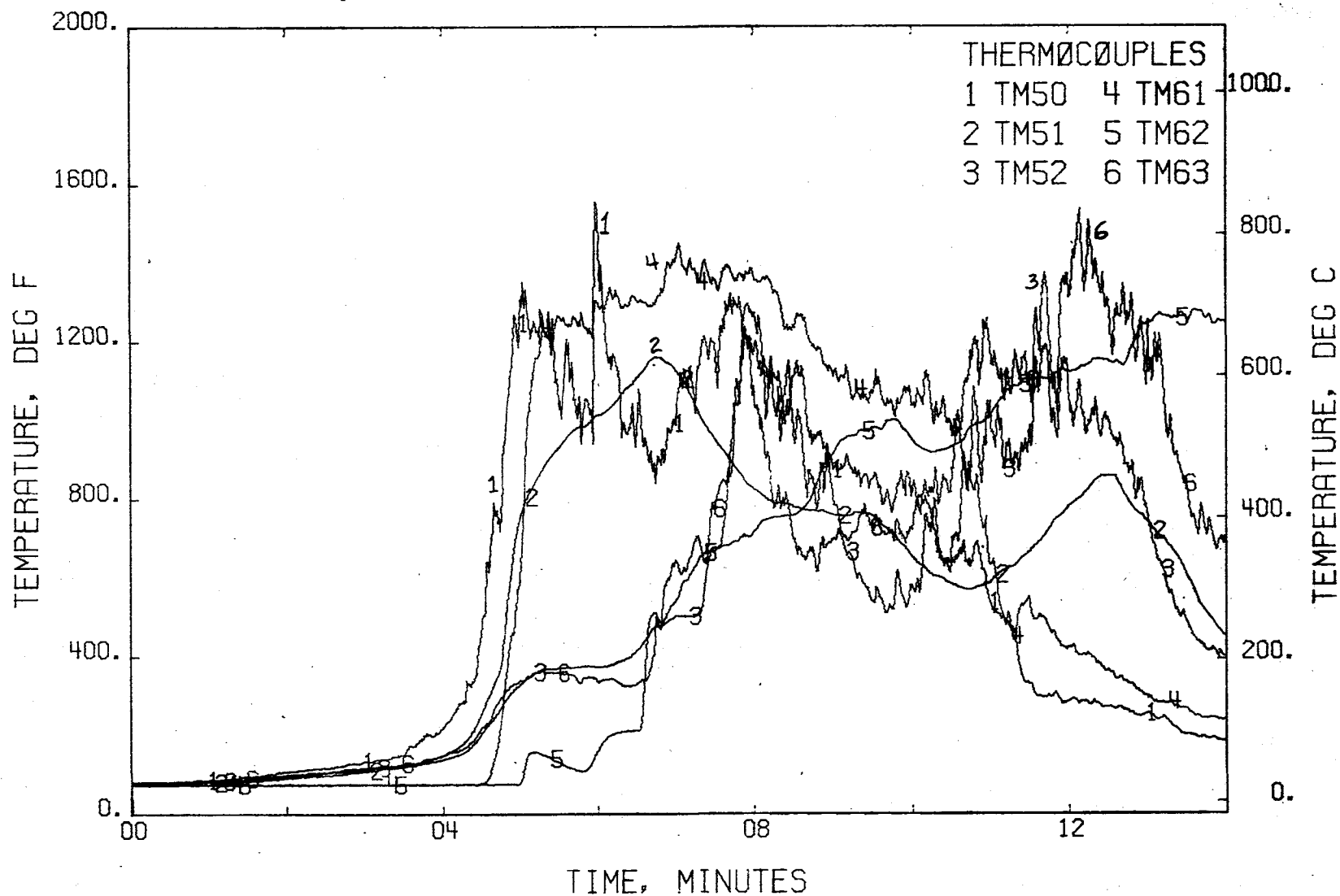


FIGURE 328 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 17

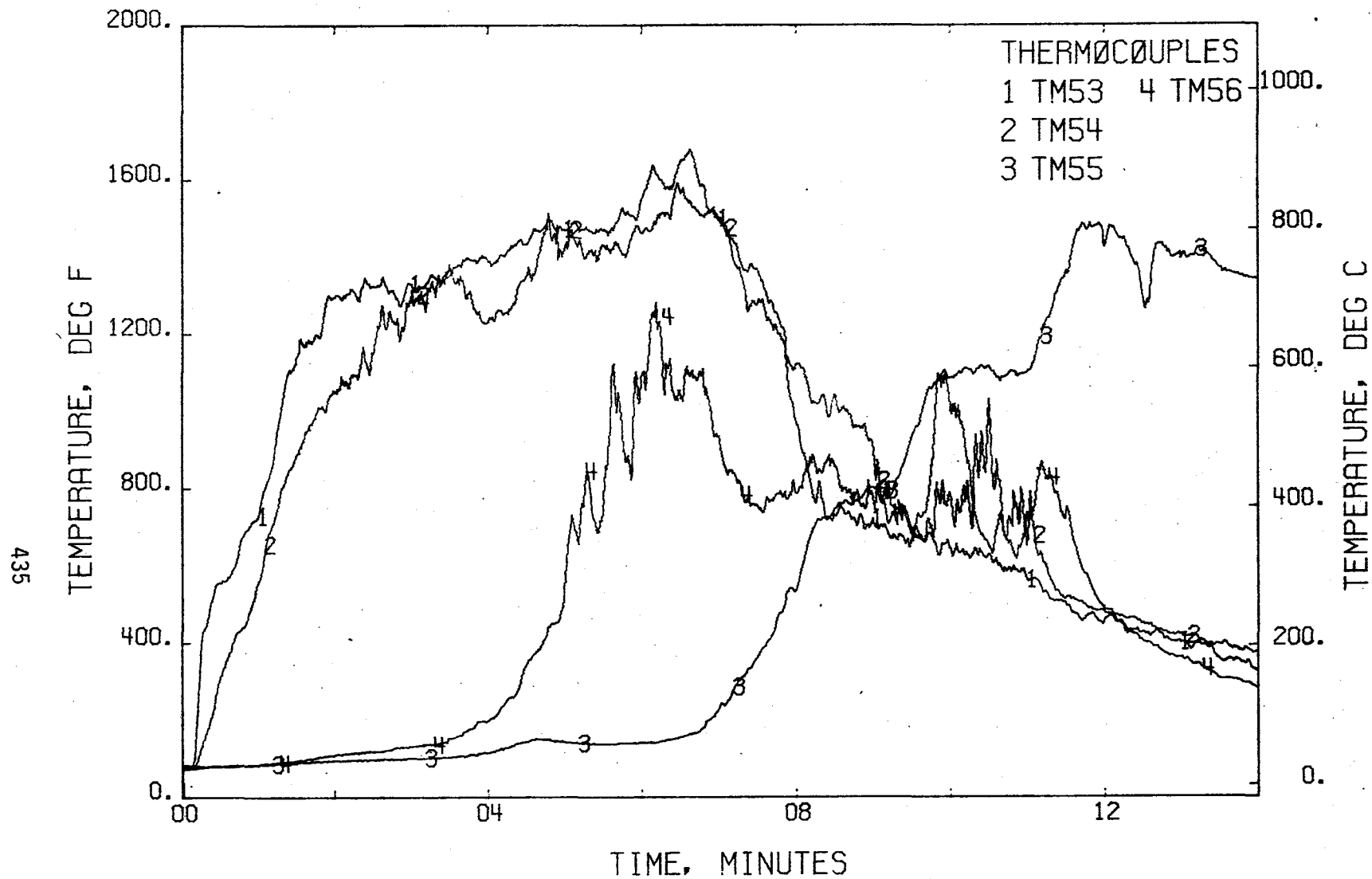


FIGURE 329 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 17

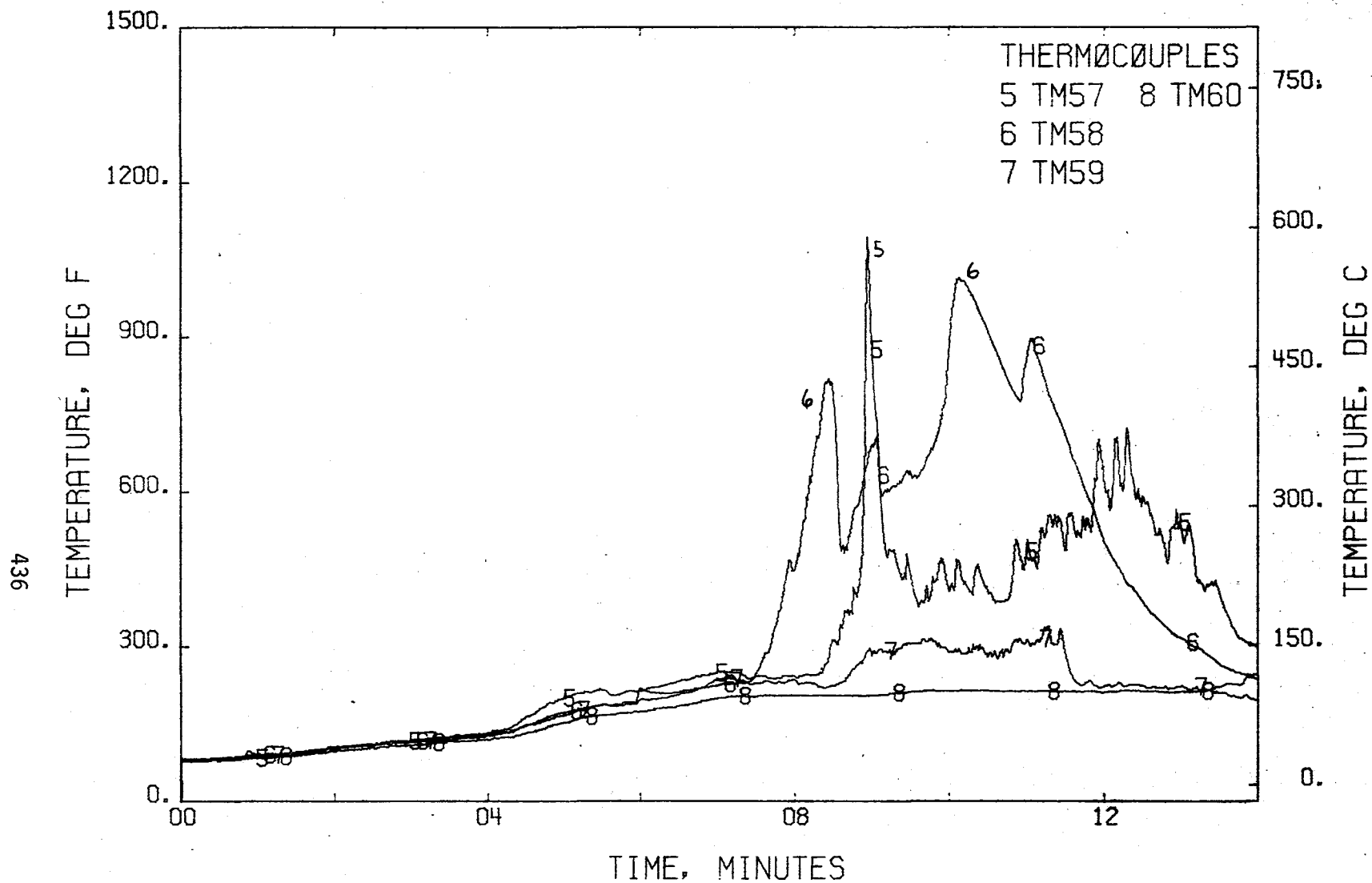


FIGURE 329 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 17

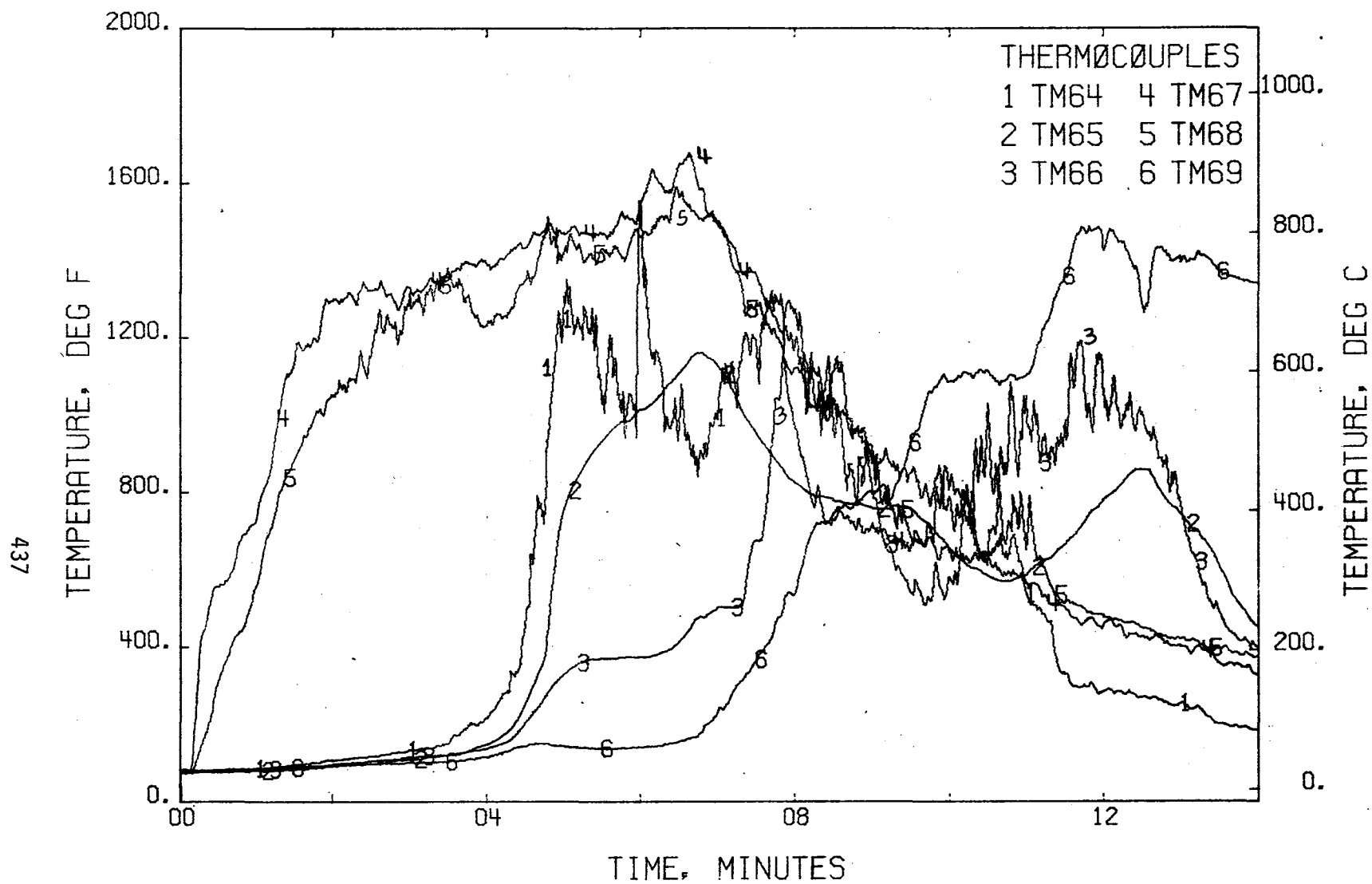


FIGURE 330 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 17

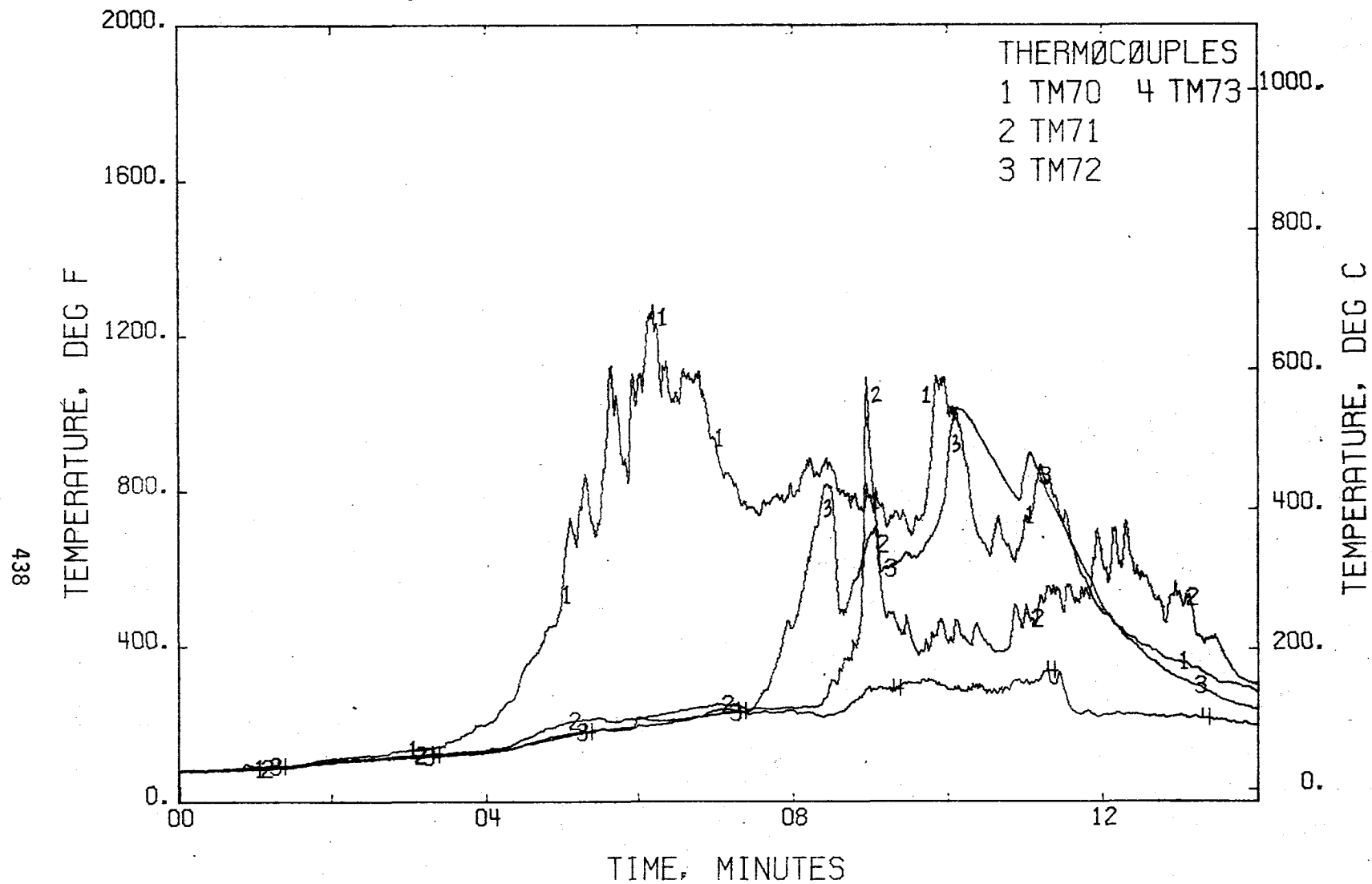


FIGURE 331 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 17

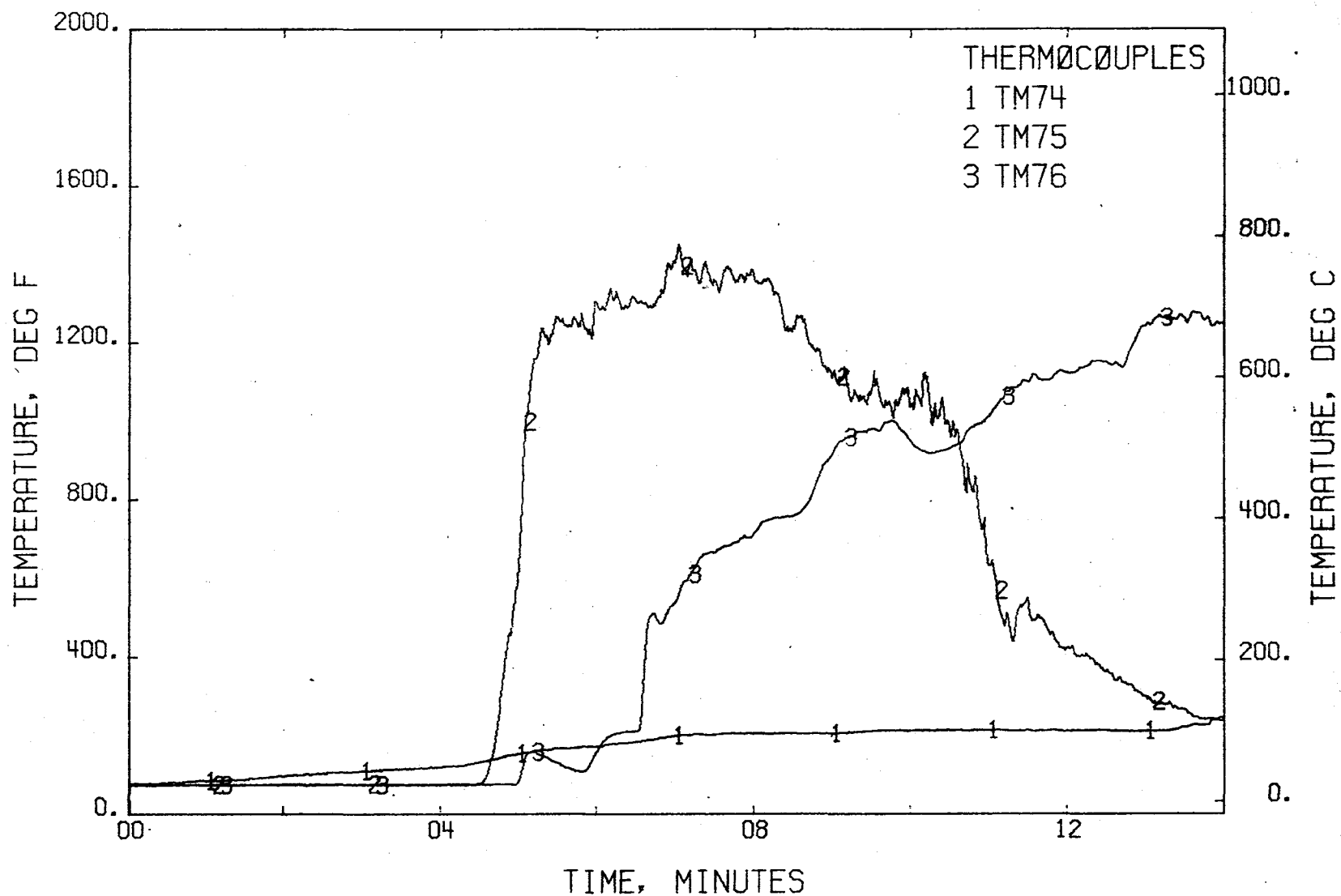


FIGURE 331 . - TEMPERATURES, SEAT BACKS (EDGES)-CONT.  
TEST 17

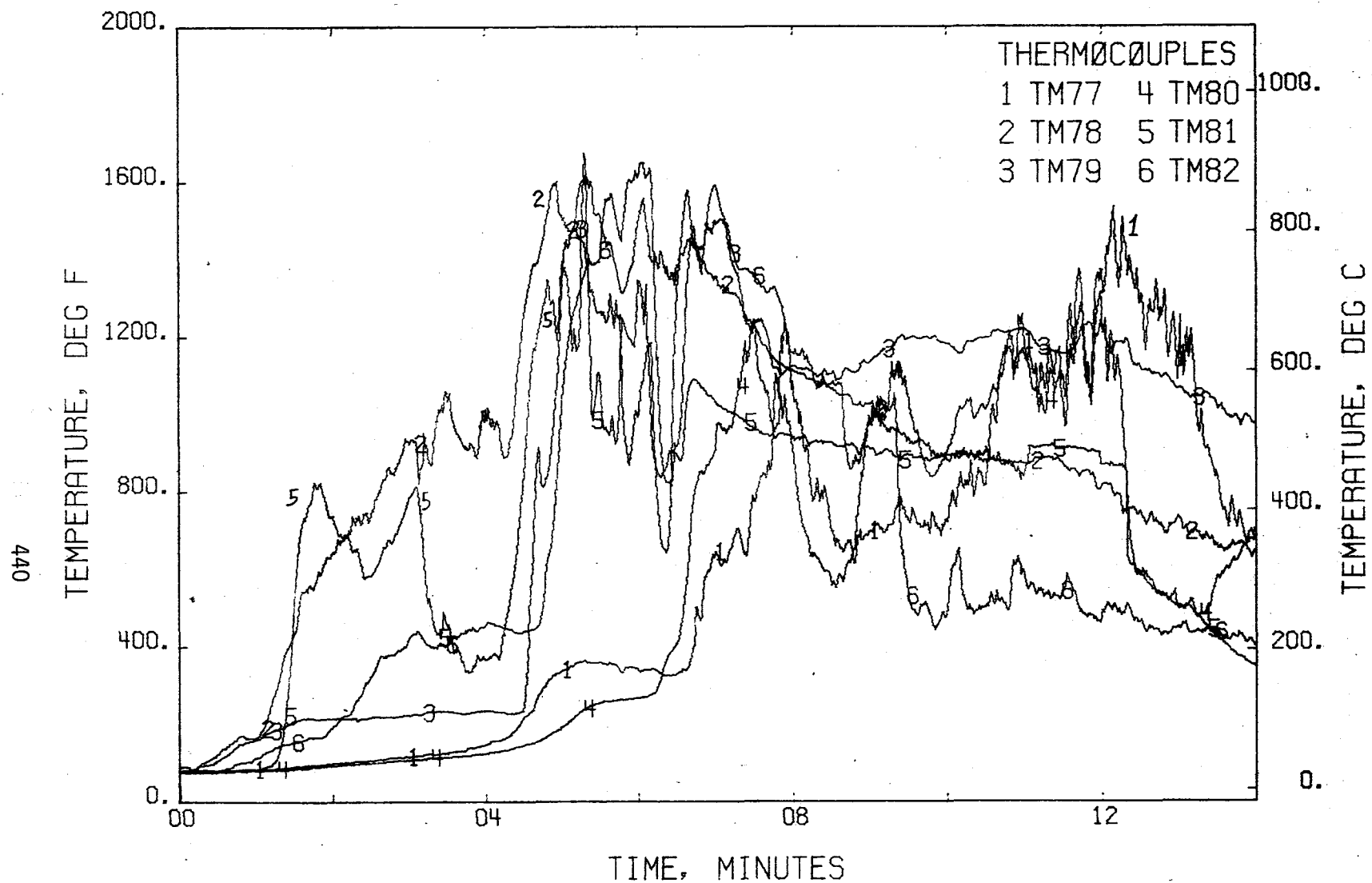


FIGURE 332 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 17



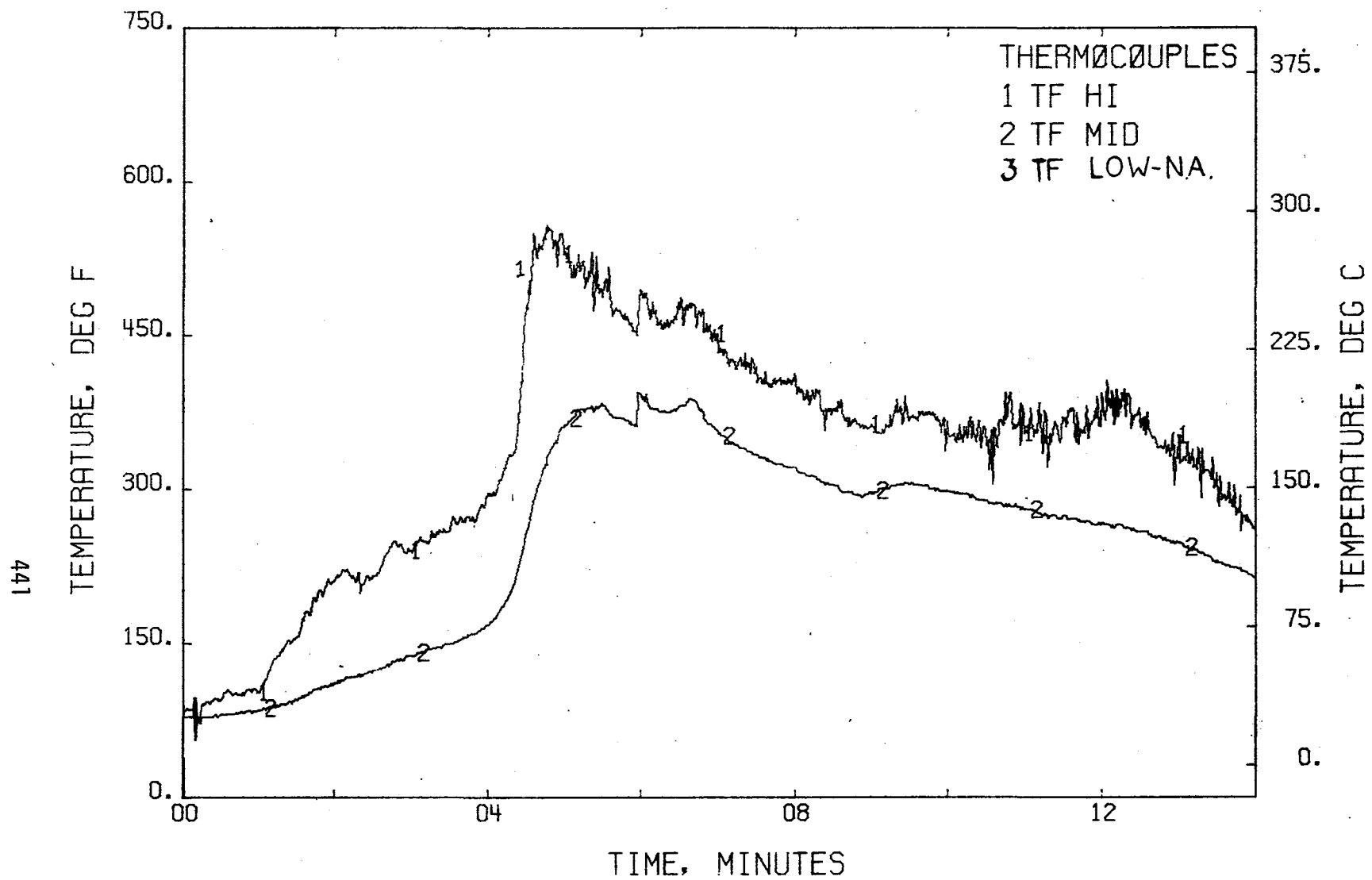


FIGURE 333 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 17

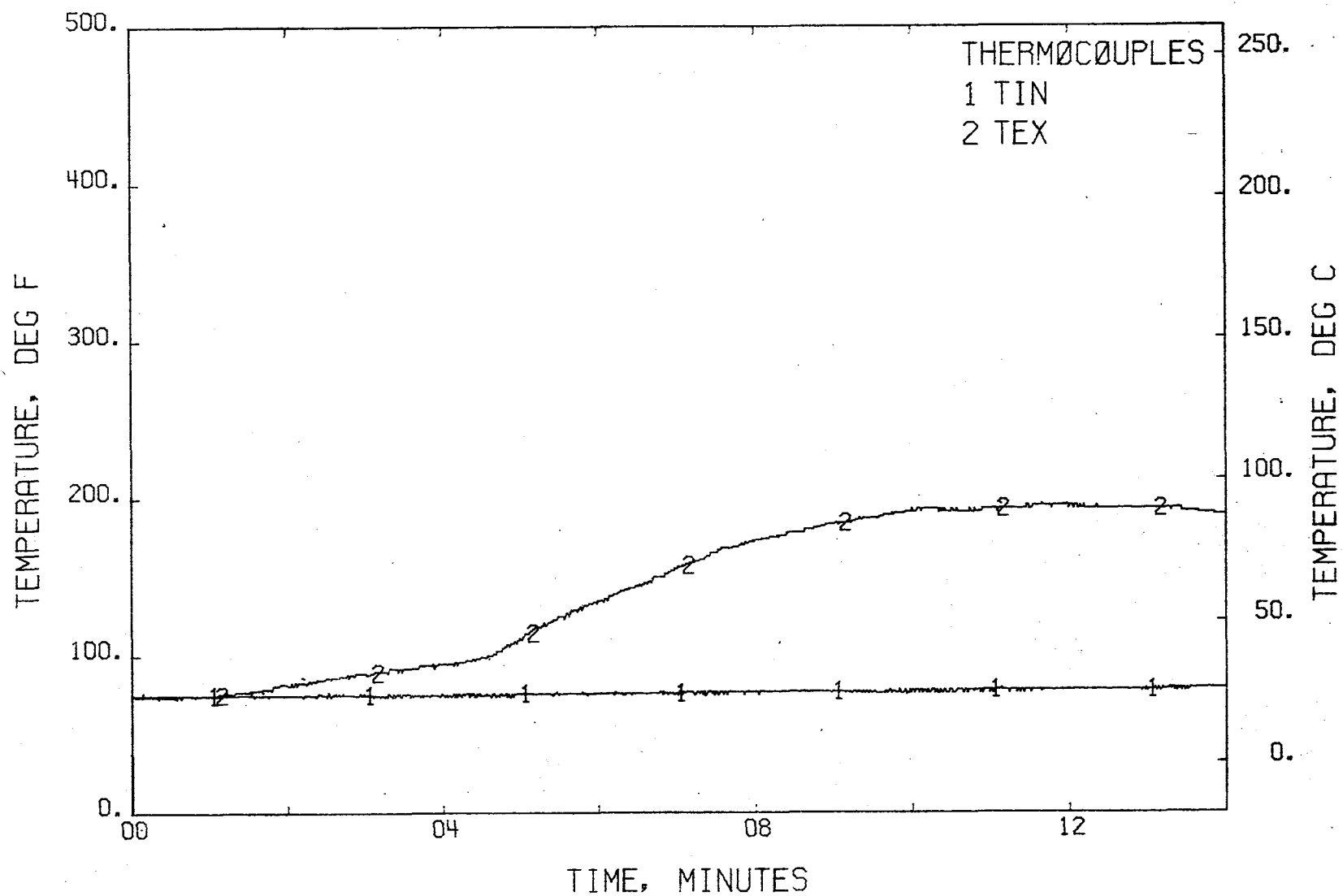


FIGURE 334 . - TEMPERATURES, INLET + EXIT  
TEST 17

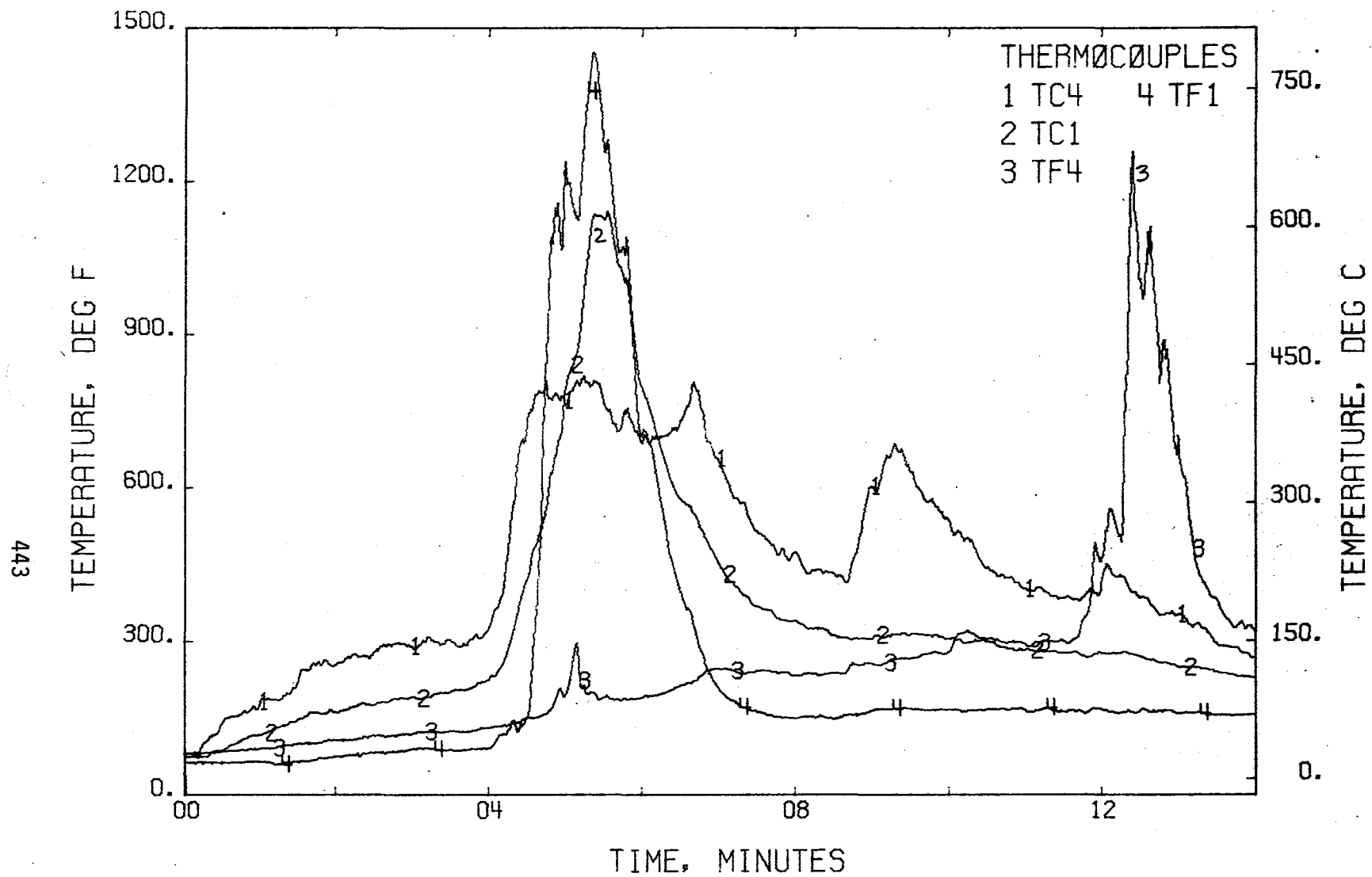


FIGURE 335 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 17

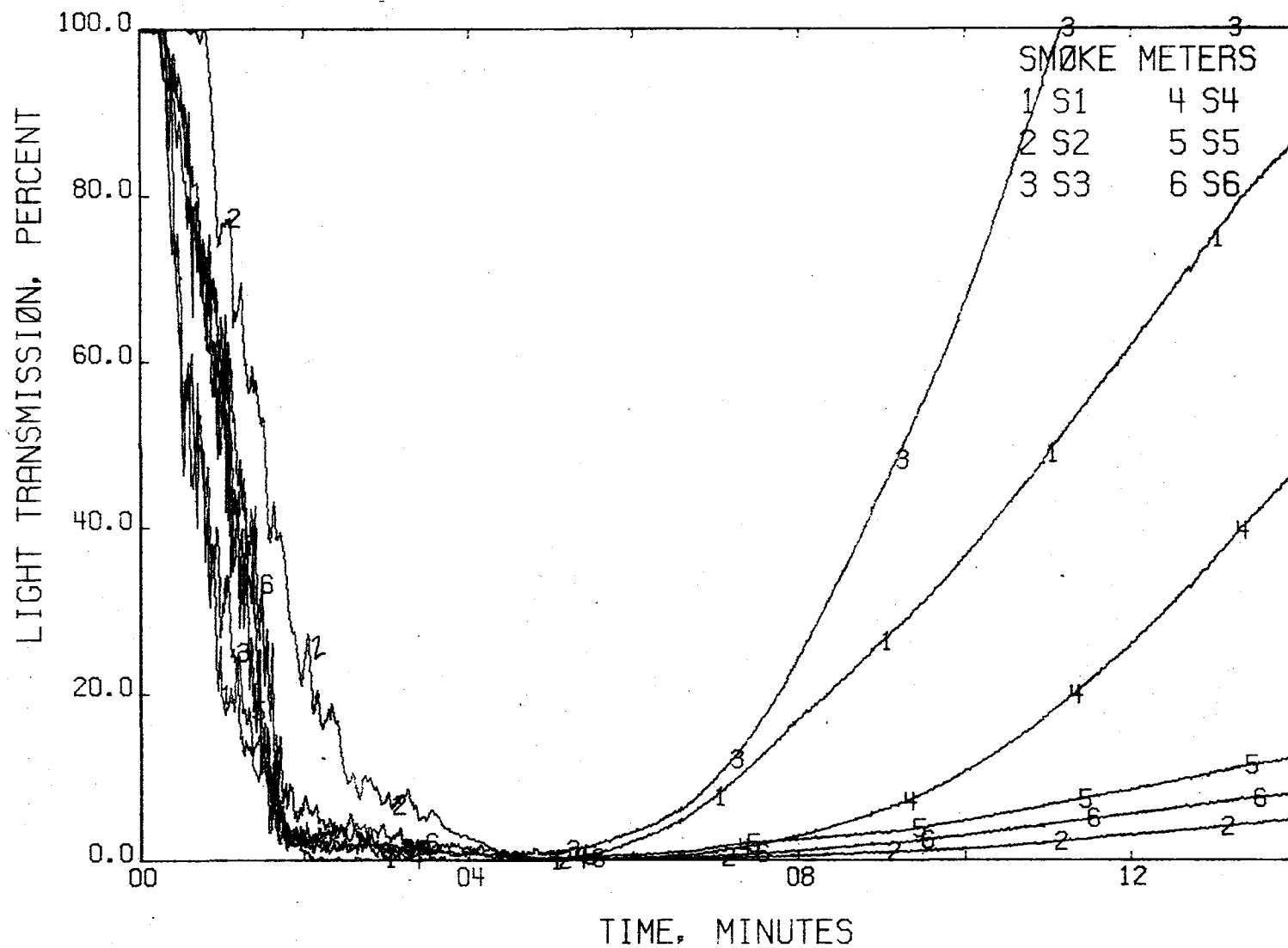


FIGURE 336 . - LIGHT TRANSMISSION  
TEST 17

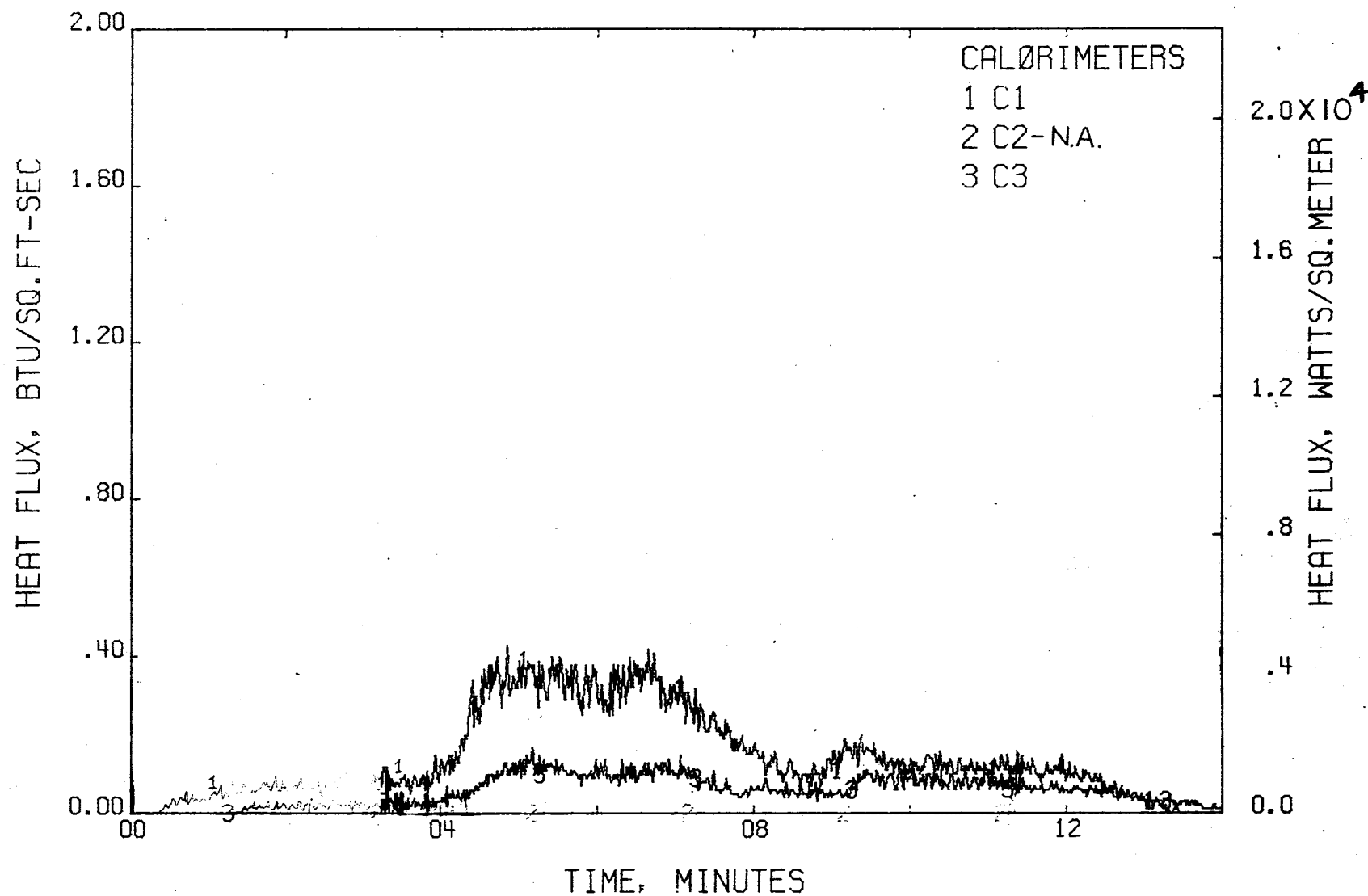


FIGURE 337 . - HEAT FLUX, AFT  
TEST 17

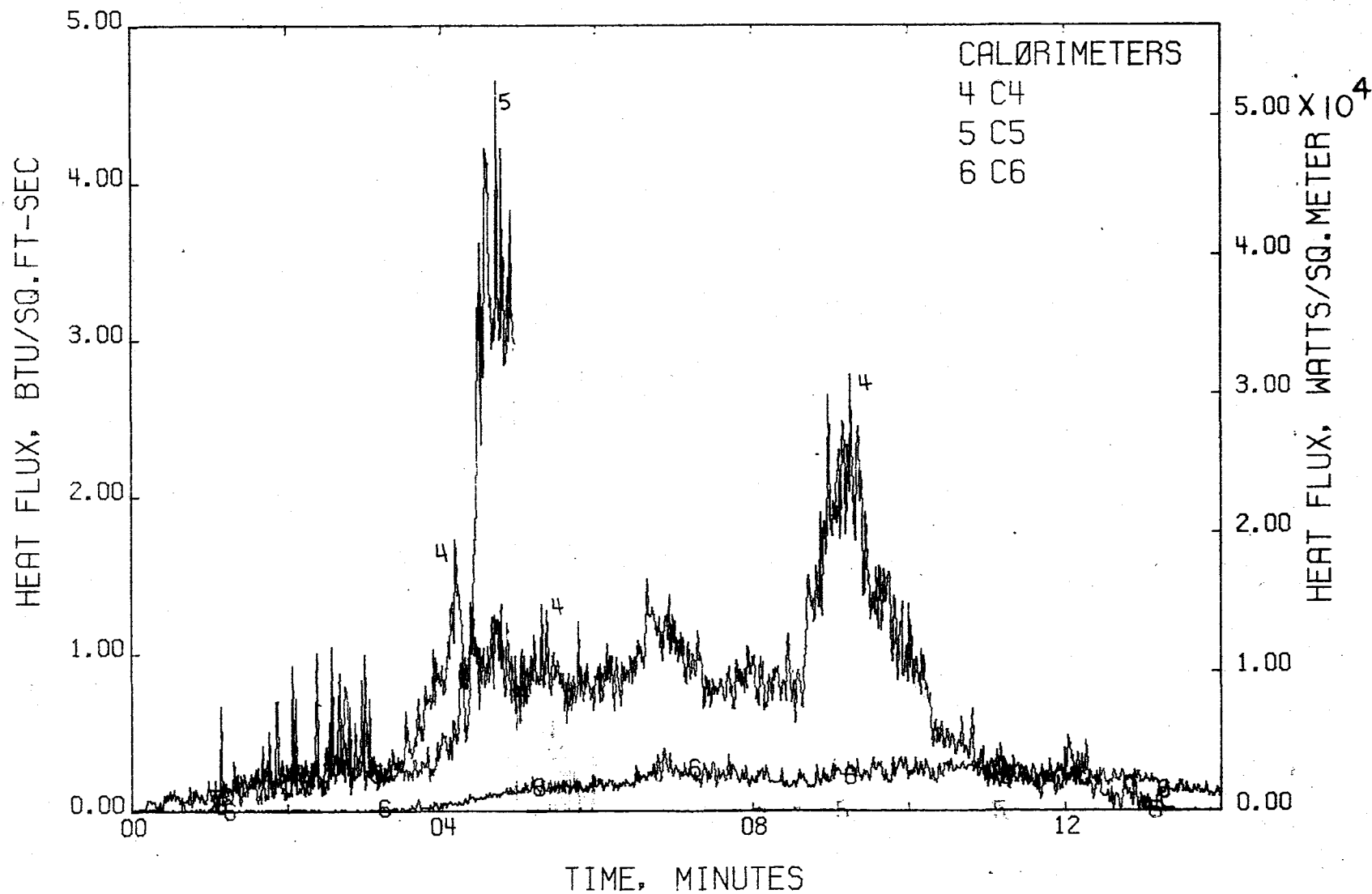


FIGURE 338 . - HEAT FLUX, MIDSECTION  
TEST 17

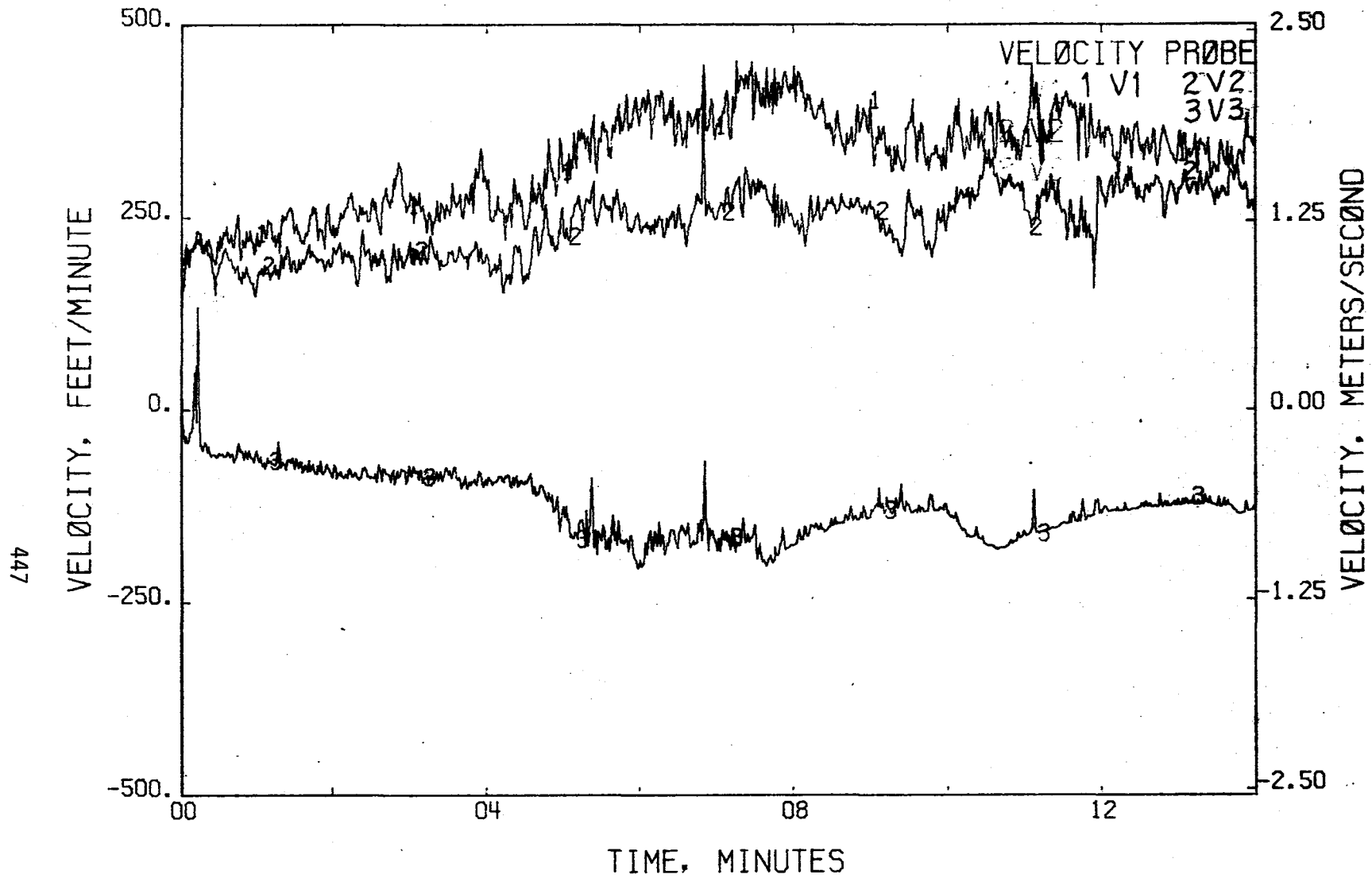


FIGURE 339 . - AIR VELOCITY  
TEST 17

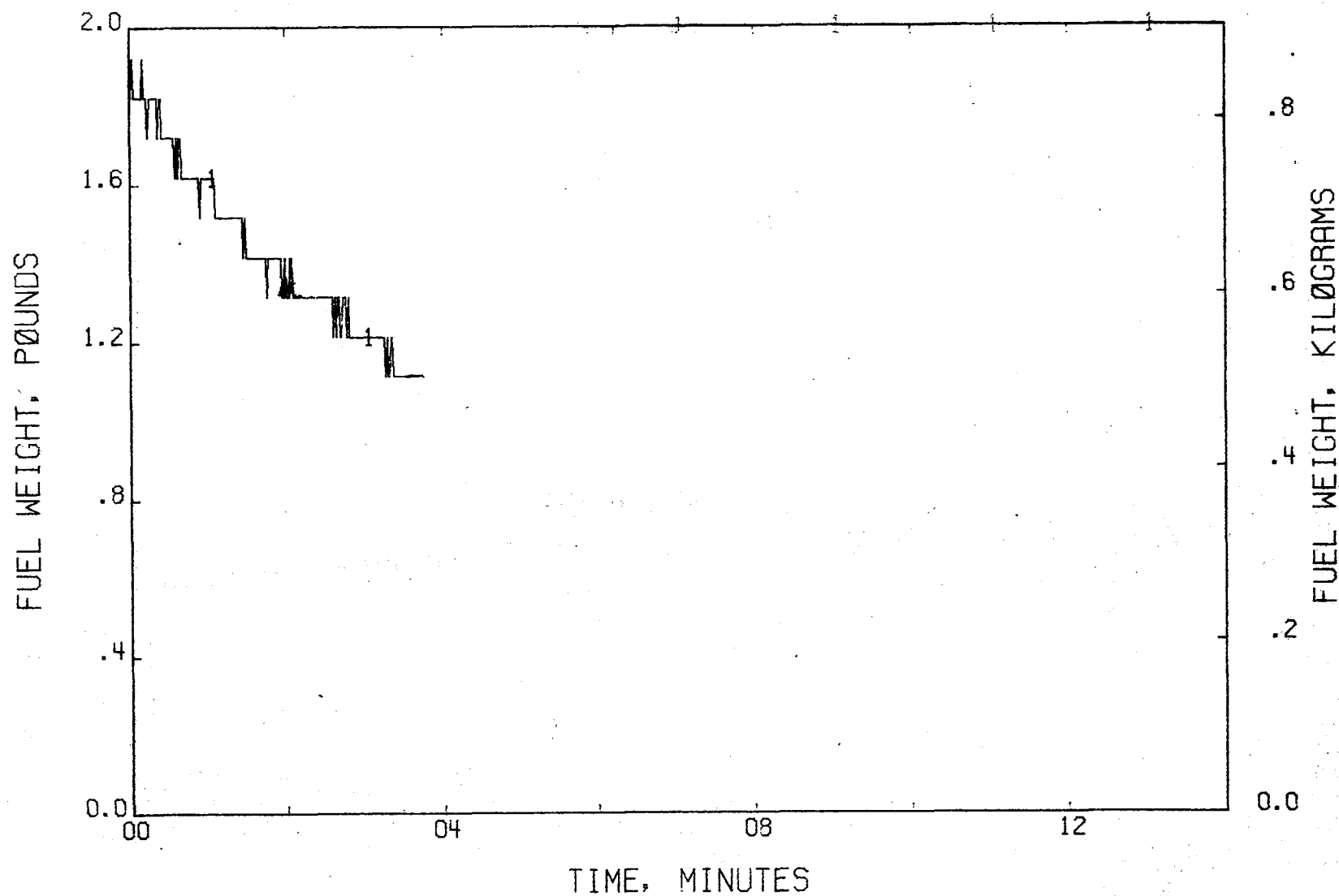


FIGURE 340 . - FUEL WEIGHT LOSS  
TEST 17



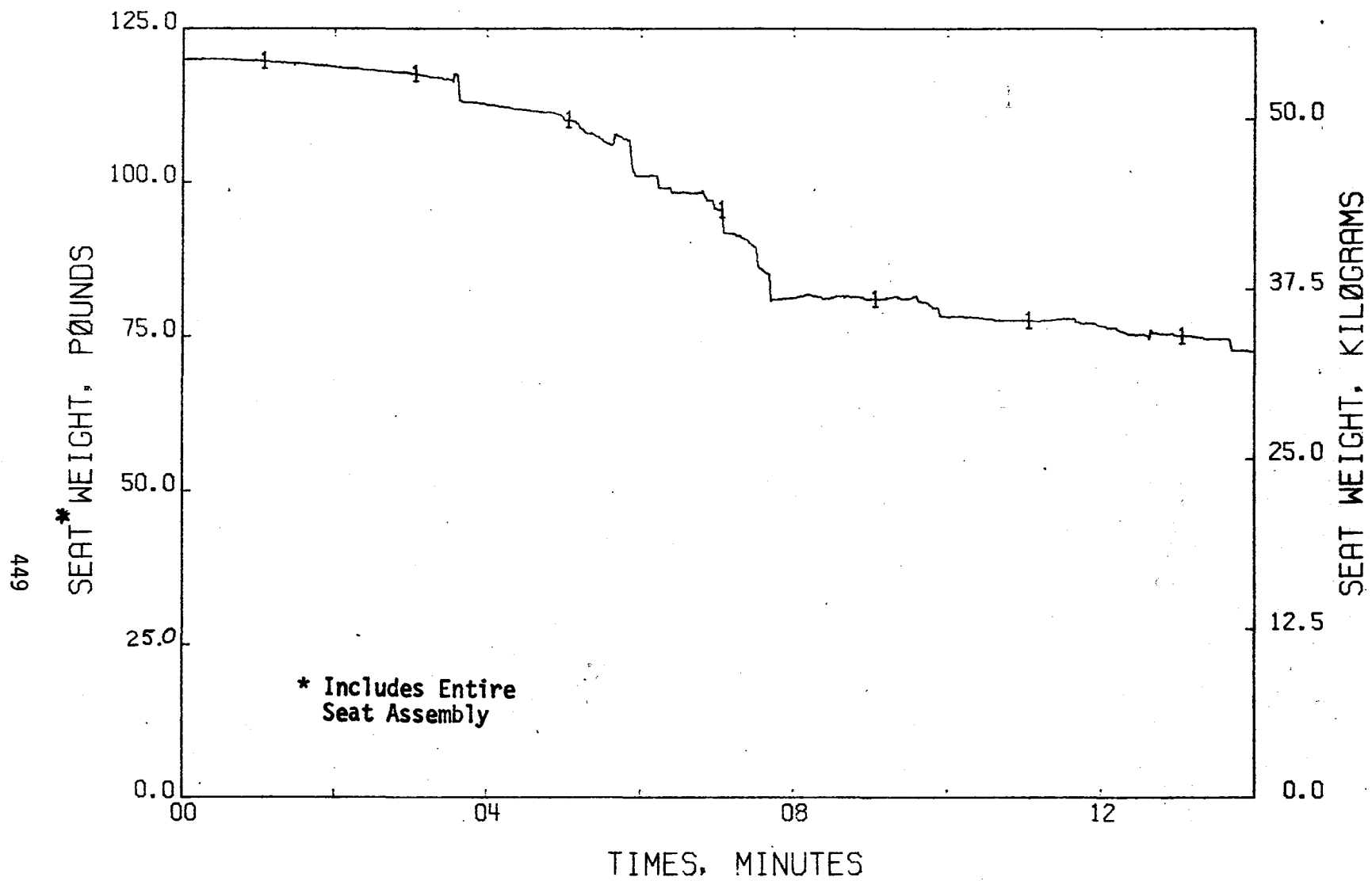


FIGURE 341 . - SEAT WEIGHT LOSS  
TEST 17

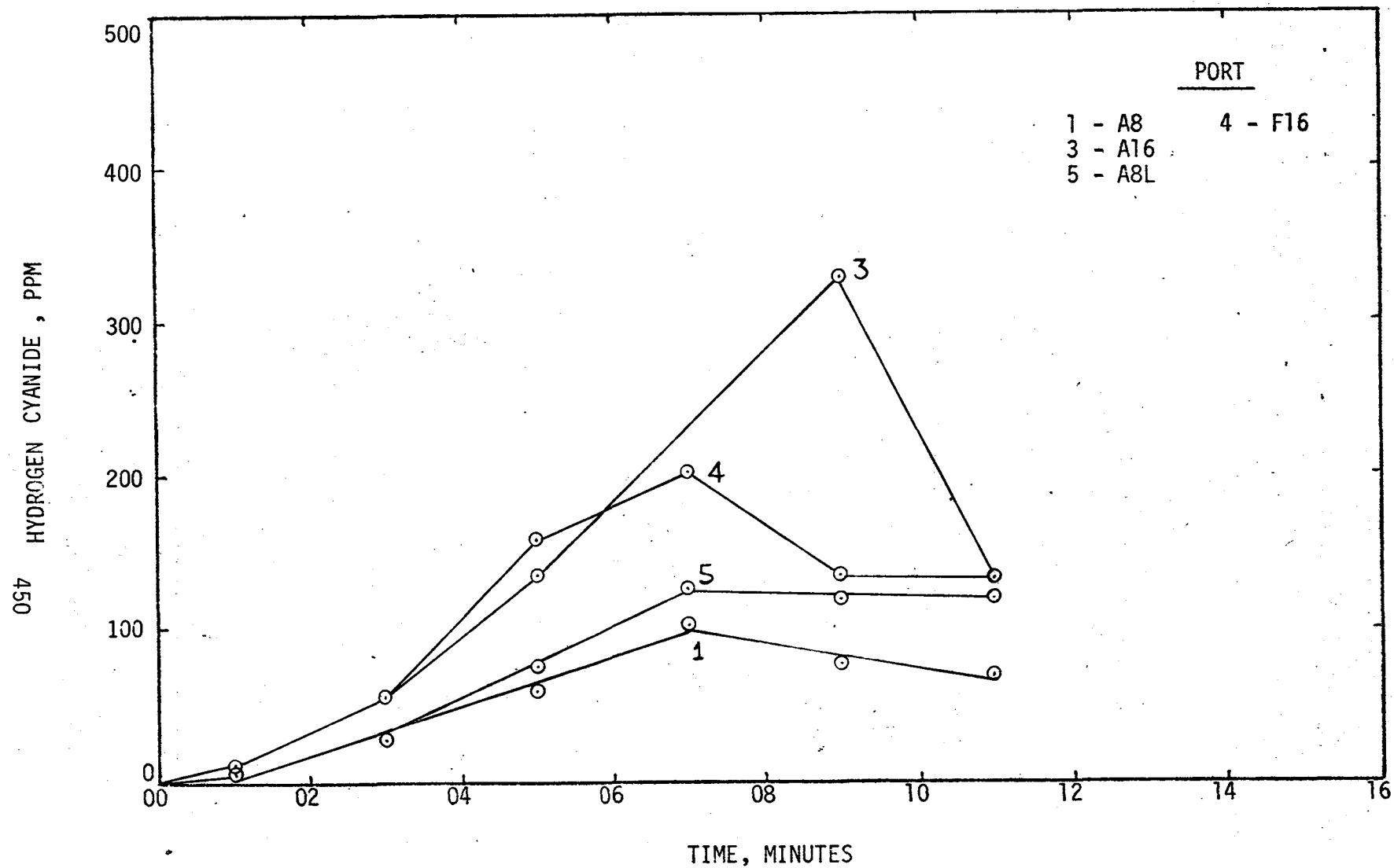


FIGURE 342 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 17

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE -  $< 3$  PPM

451

FIGURE 343 . - HYDROGEN FLUORIDE CONCENTRATIONS  
TEST 17

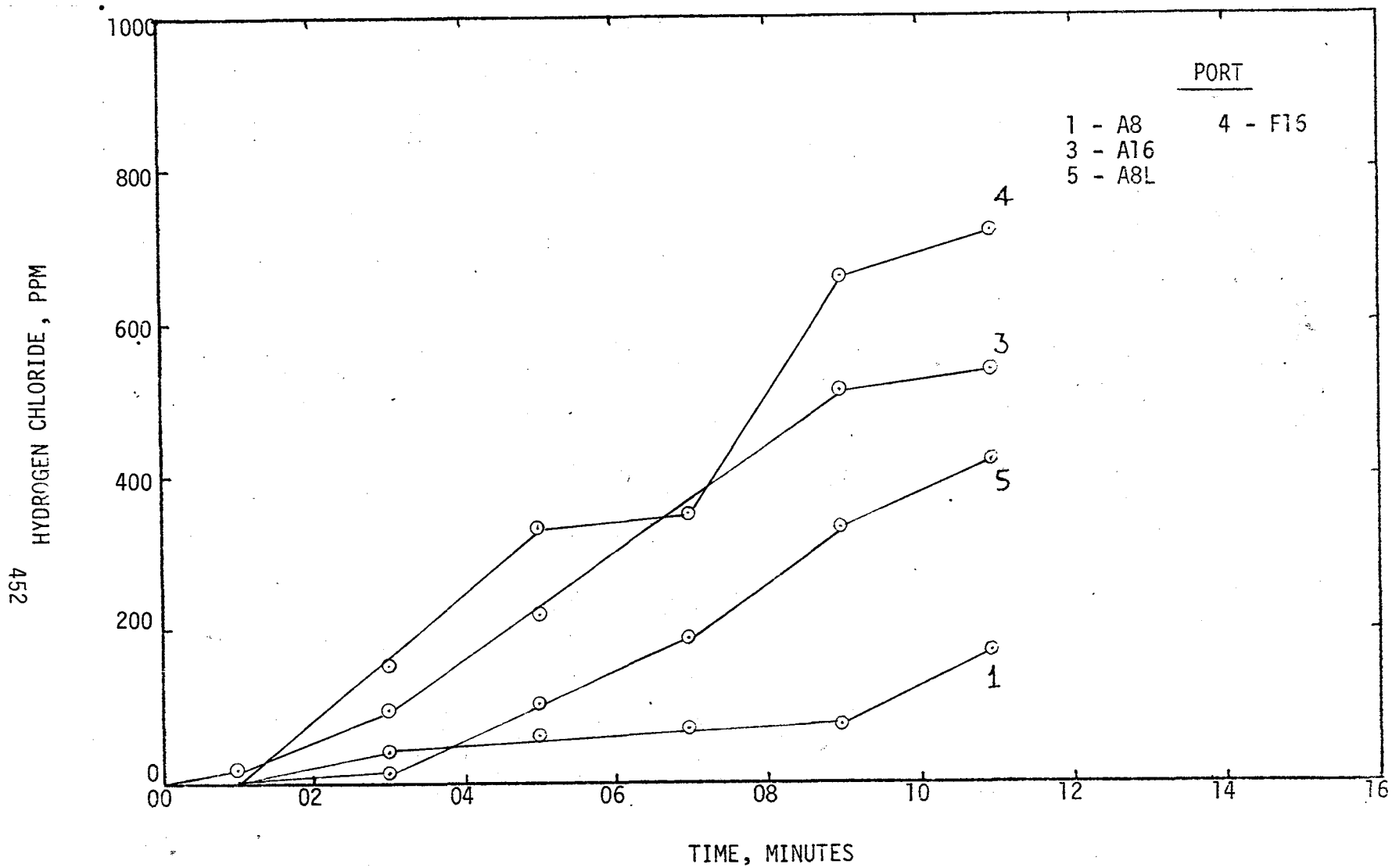


FIGURE 344 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 17

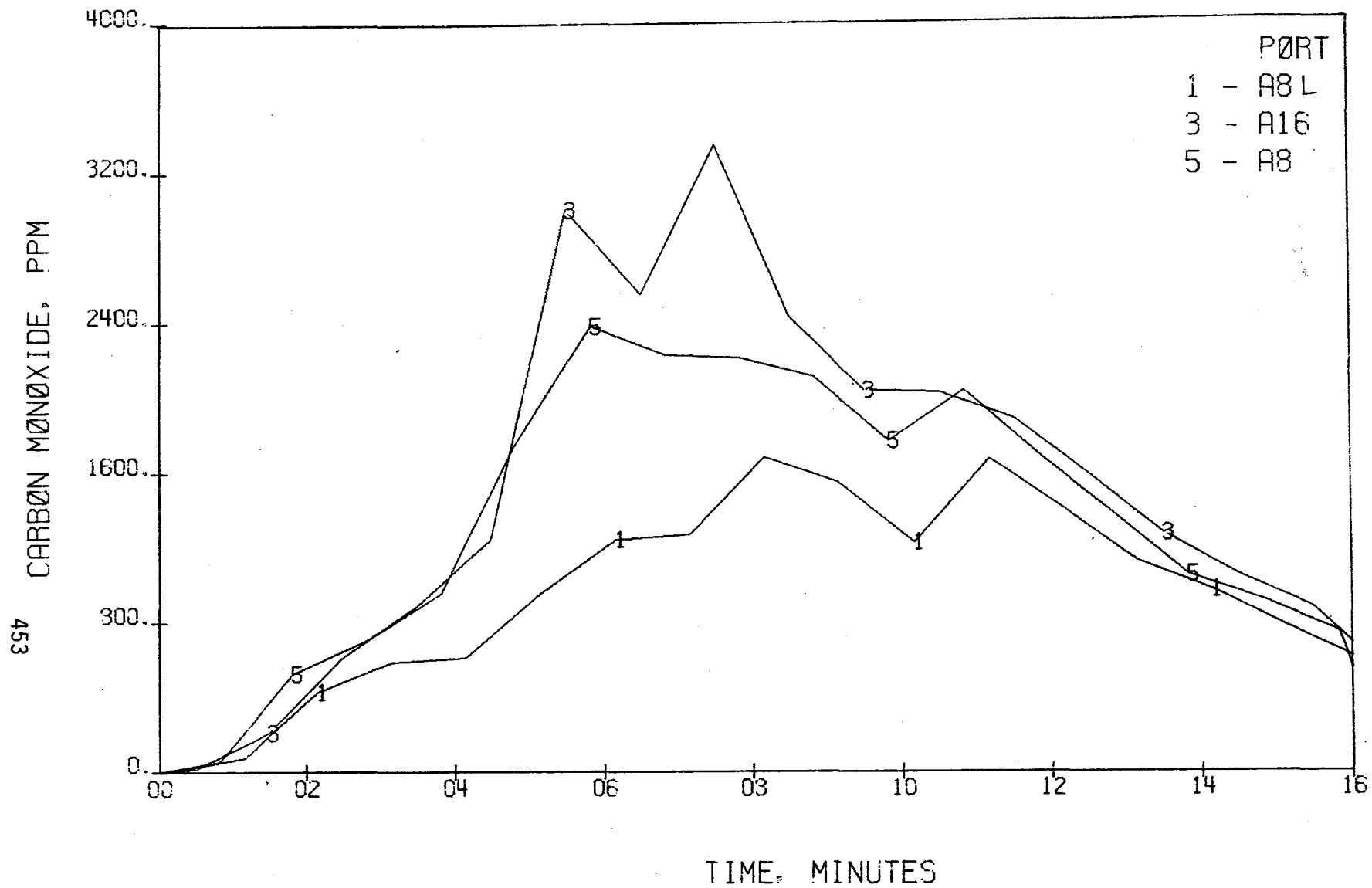


FIGURE 345 . - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 17

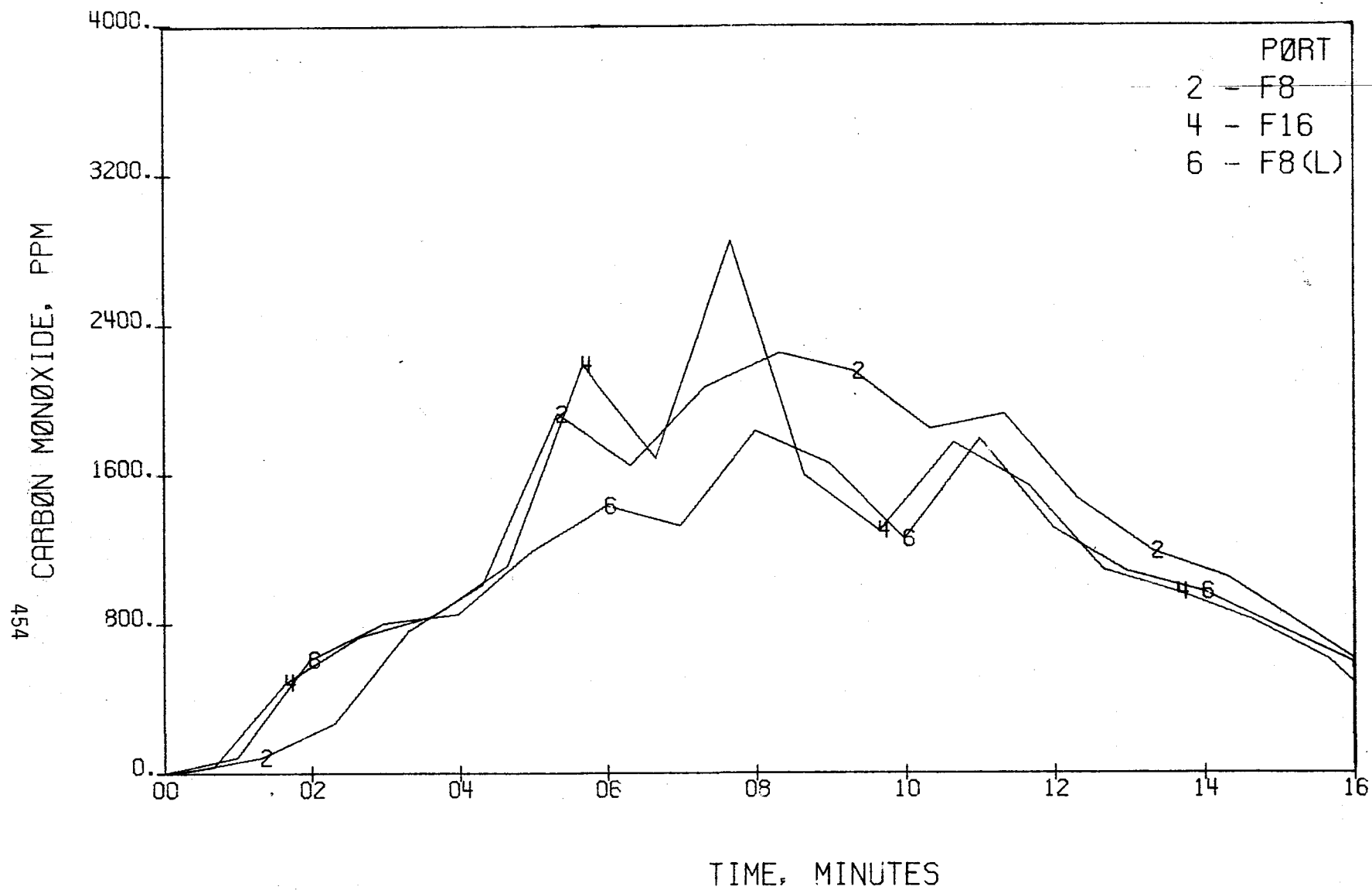


FIGURE 346 . - CARBON MONOXIDE CONCENTRATIONS, FØRE  
TEST 17

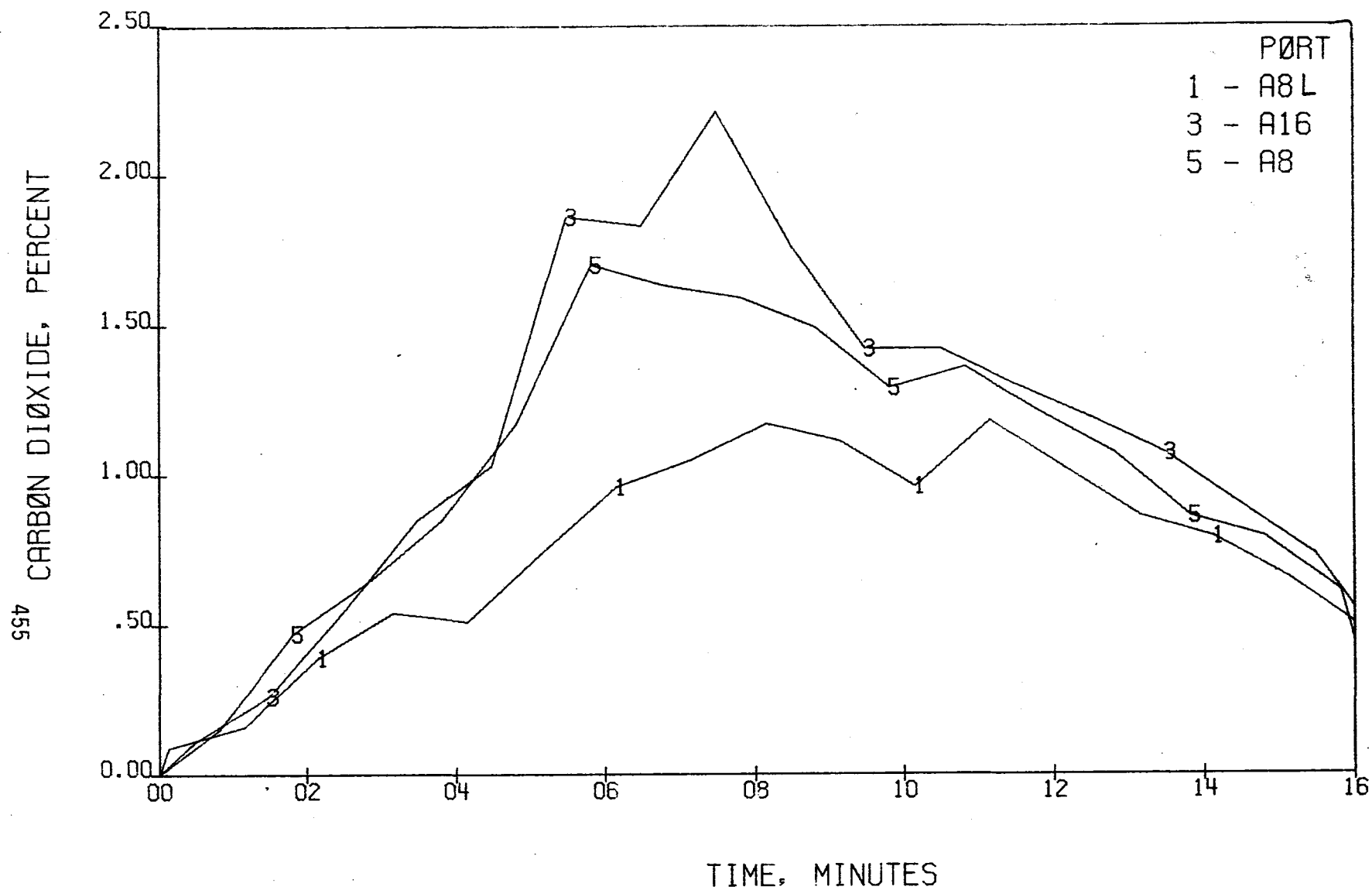


FIGURE 347 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 17

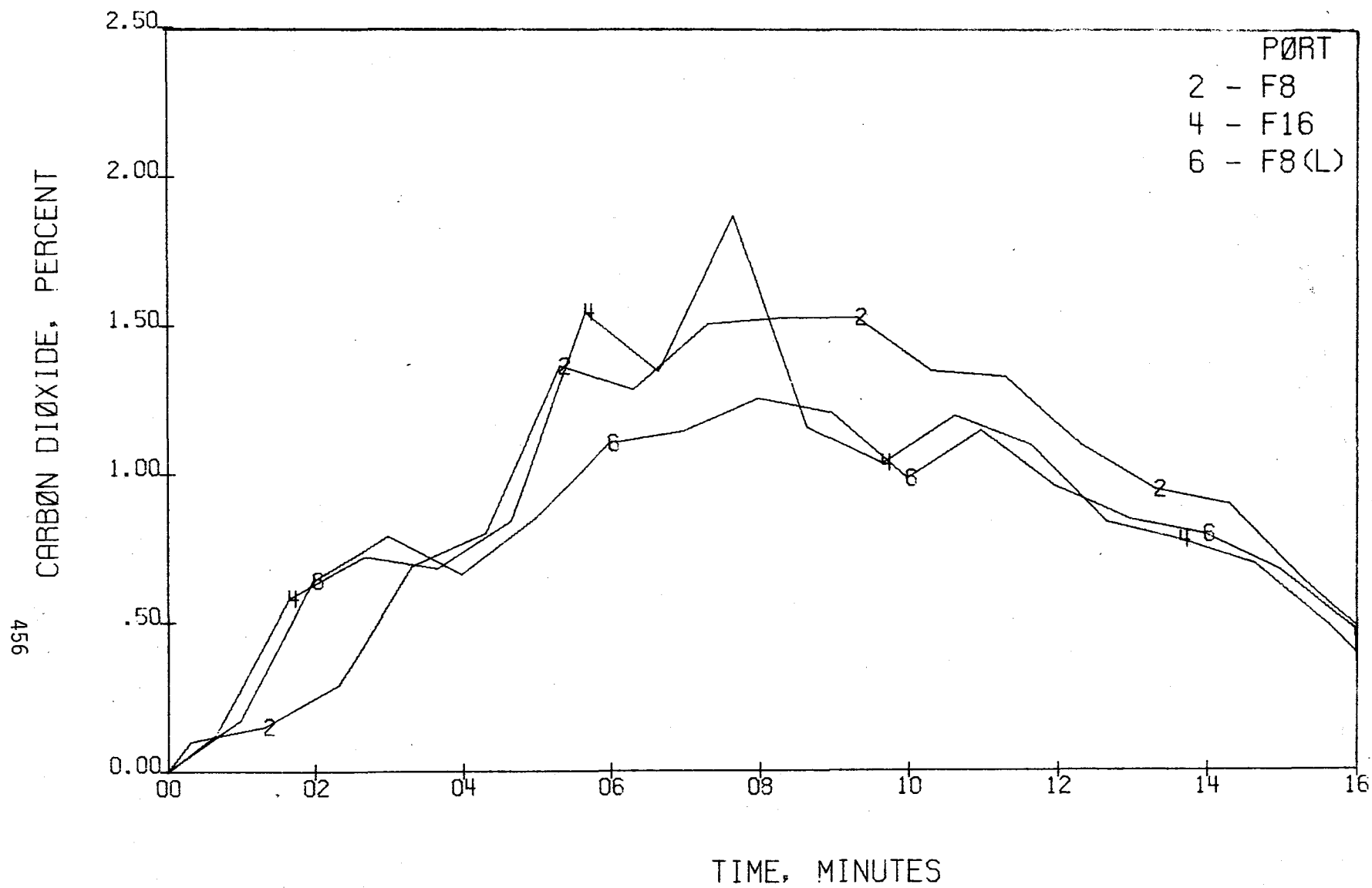


FIGURE 348 - CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 17



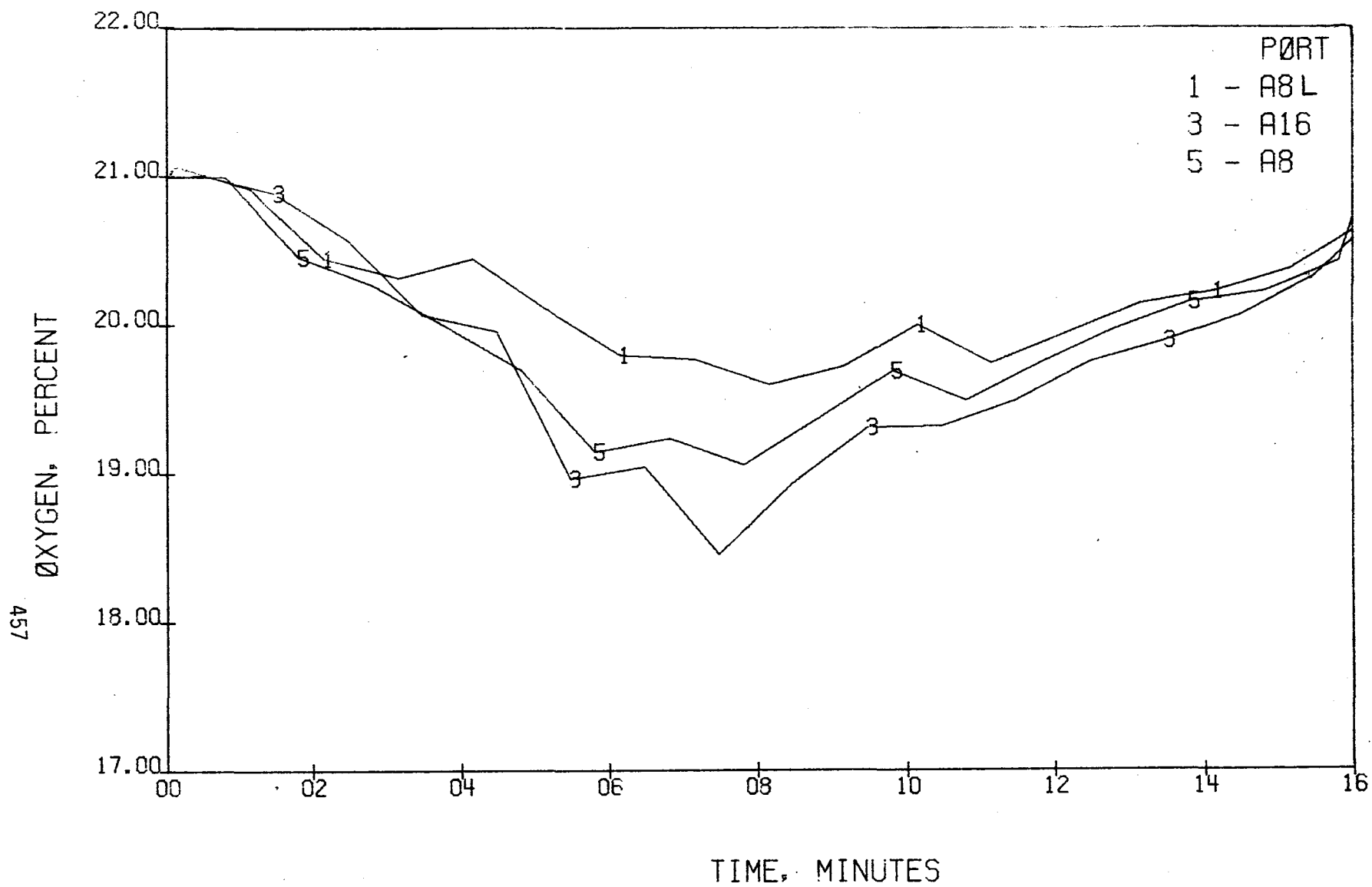


FIGURE 349 . - OXYGEN CONCENTRATIONS, AFT  
TEST 17

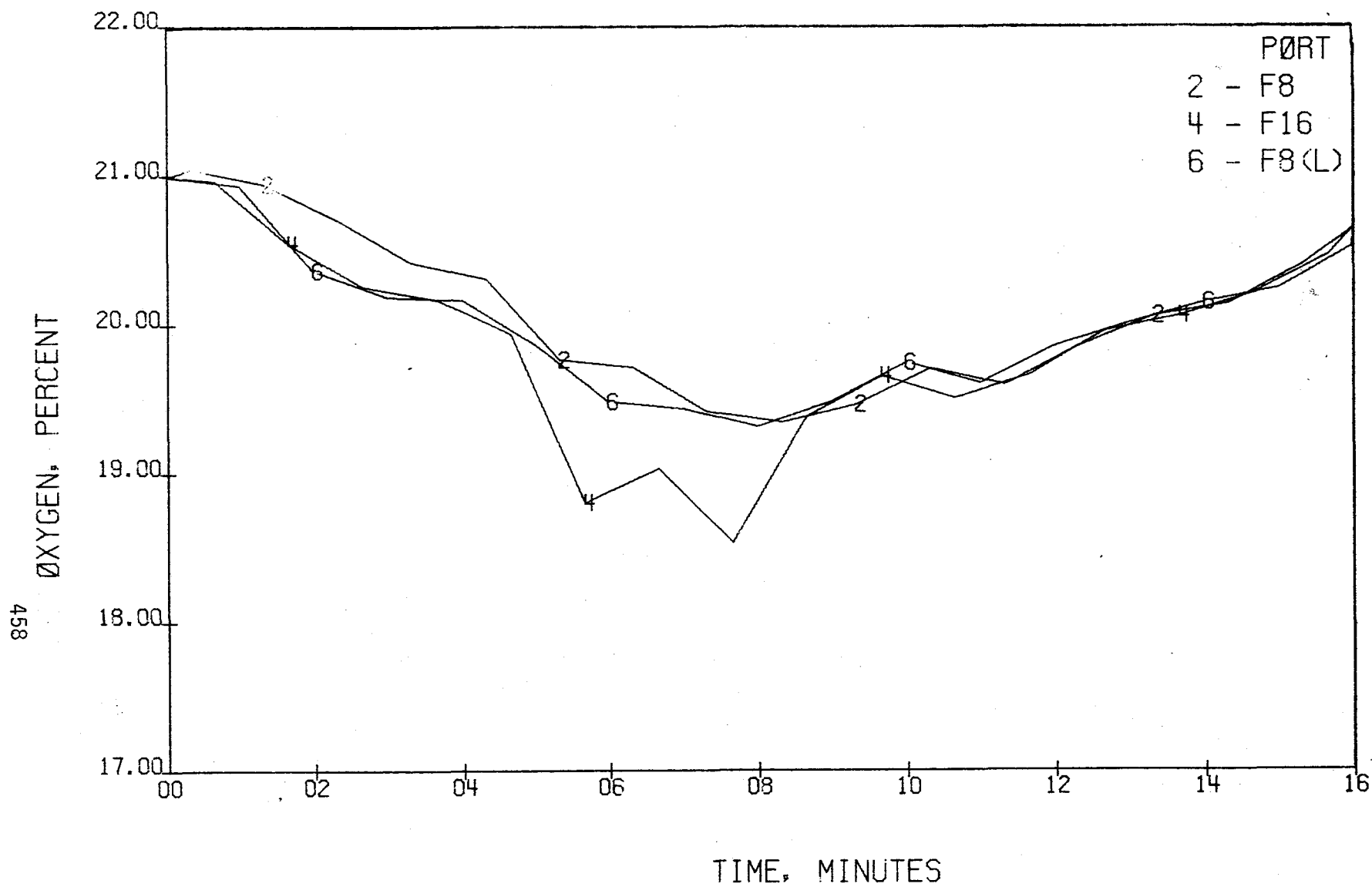


FIGURE 350 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 17

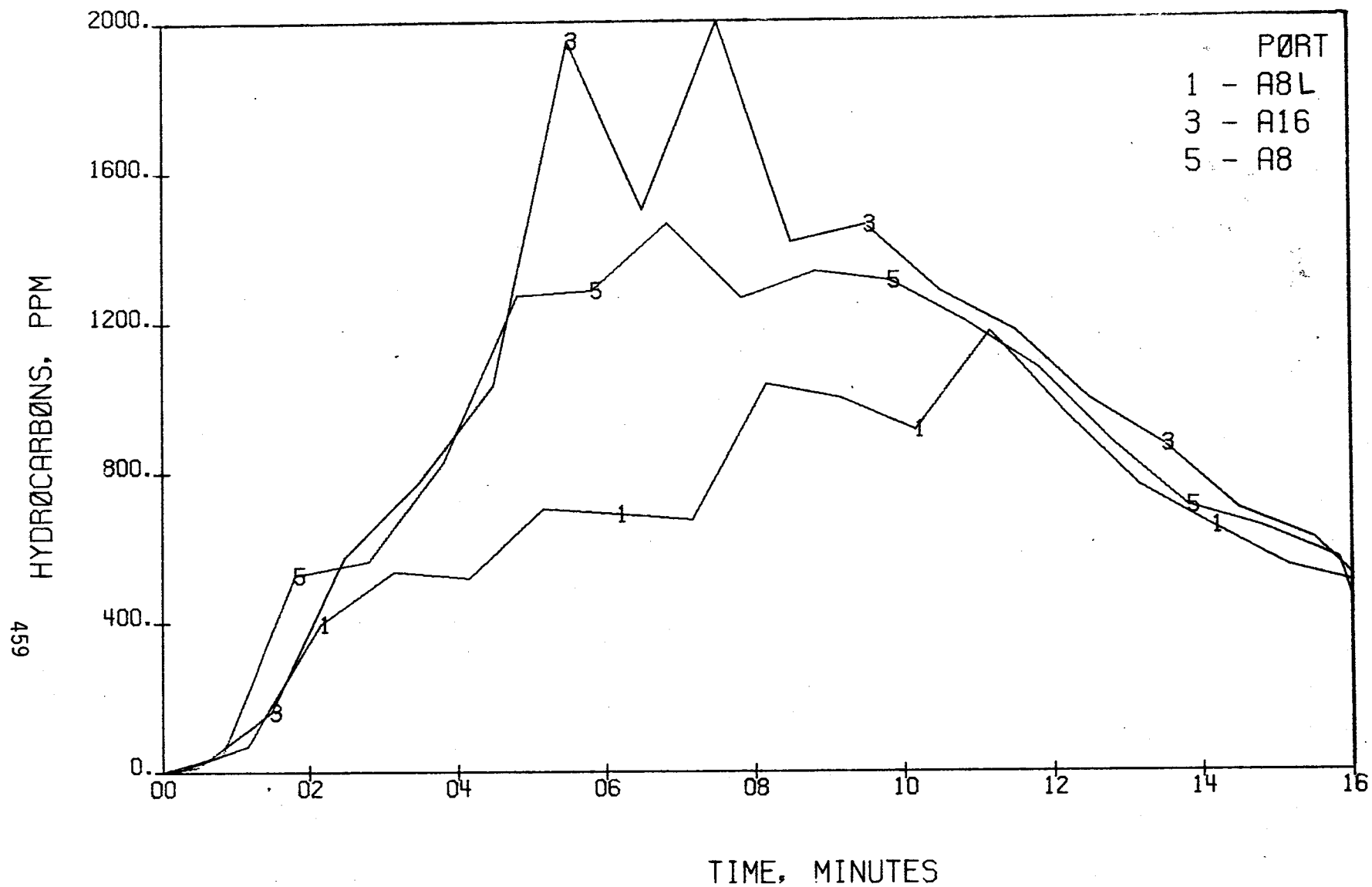


FIGURE 351 . - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 17

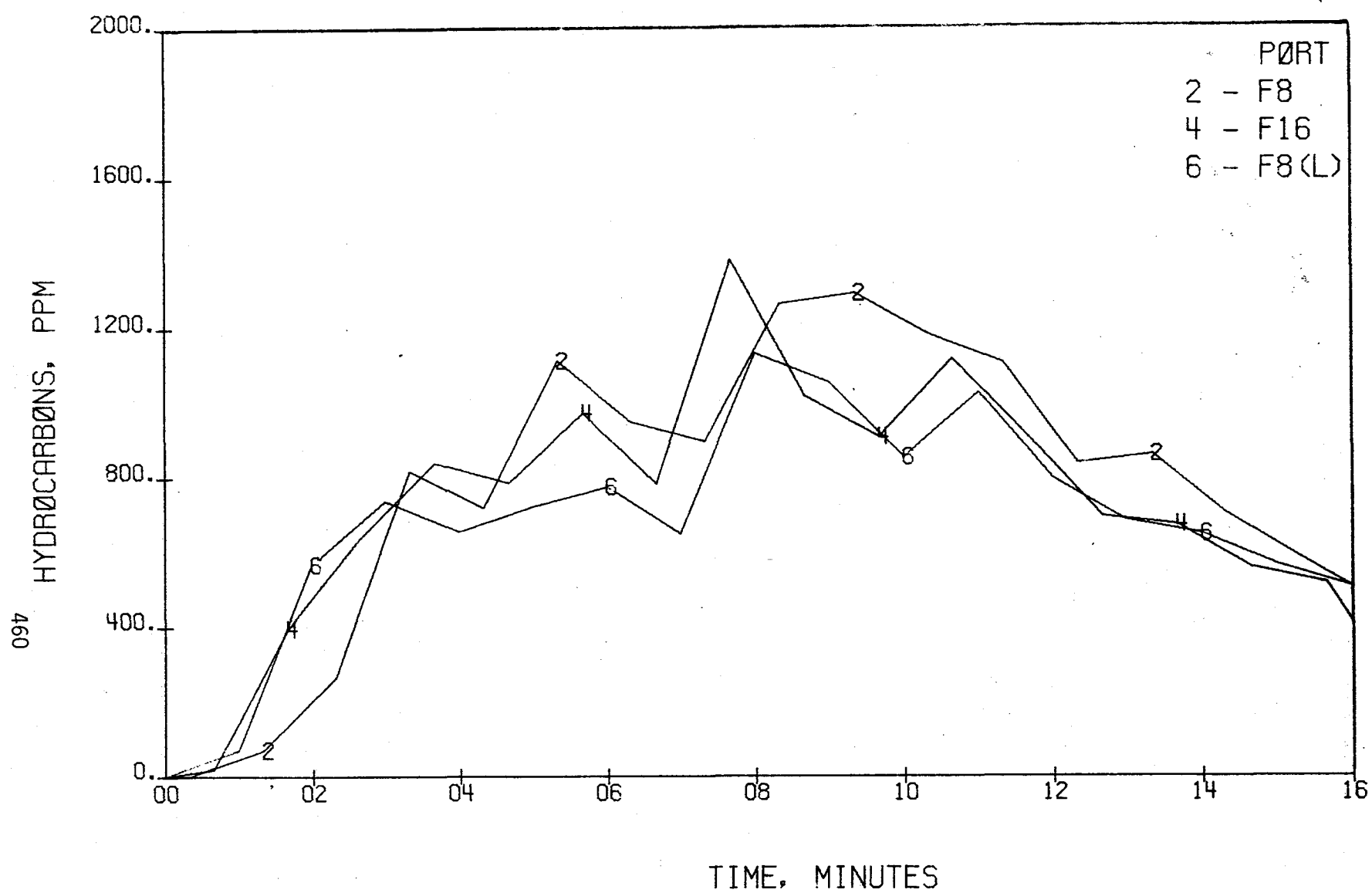


FIGURE 352 - HYDROCARBONS CONCENTRATIONS, FØRE  
TEST 17

TEST 18

---

BARE IH-1720 POLYIMIDE FOAM SEATS

TEST 18

BARE IH-1720 POLYIMIDE FOAM SEATS



FIGURE 353 . - PRE-TEST CONFIGURATION, TEST 18

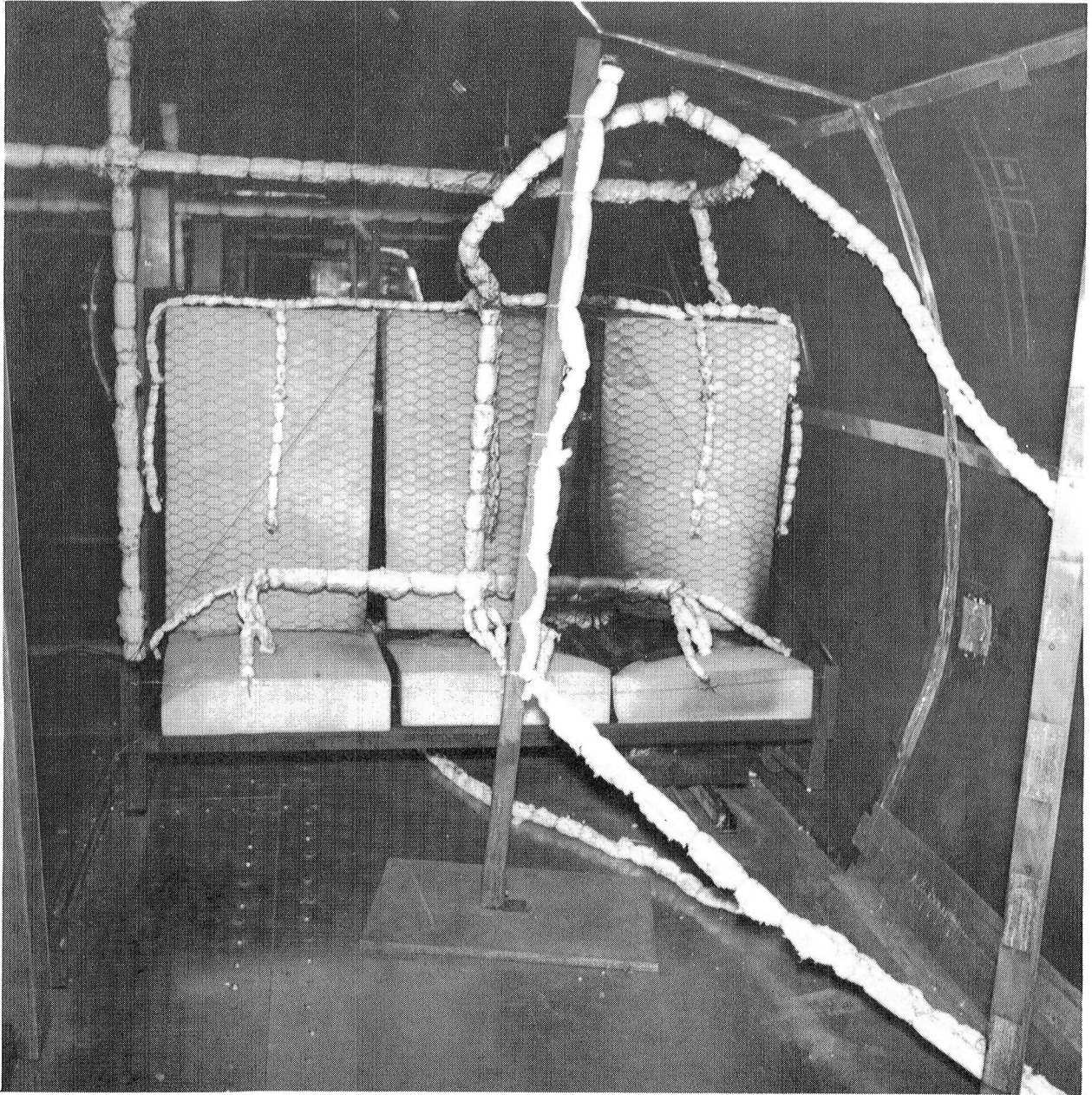


FIGURE 354 . - POST-TEST CONFIGURATION, TEST 18





FIGURE 355 . - FIRE DURING TEST 18



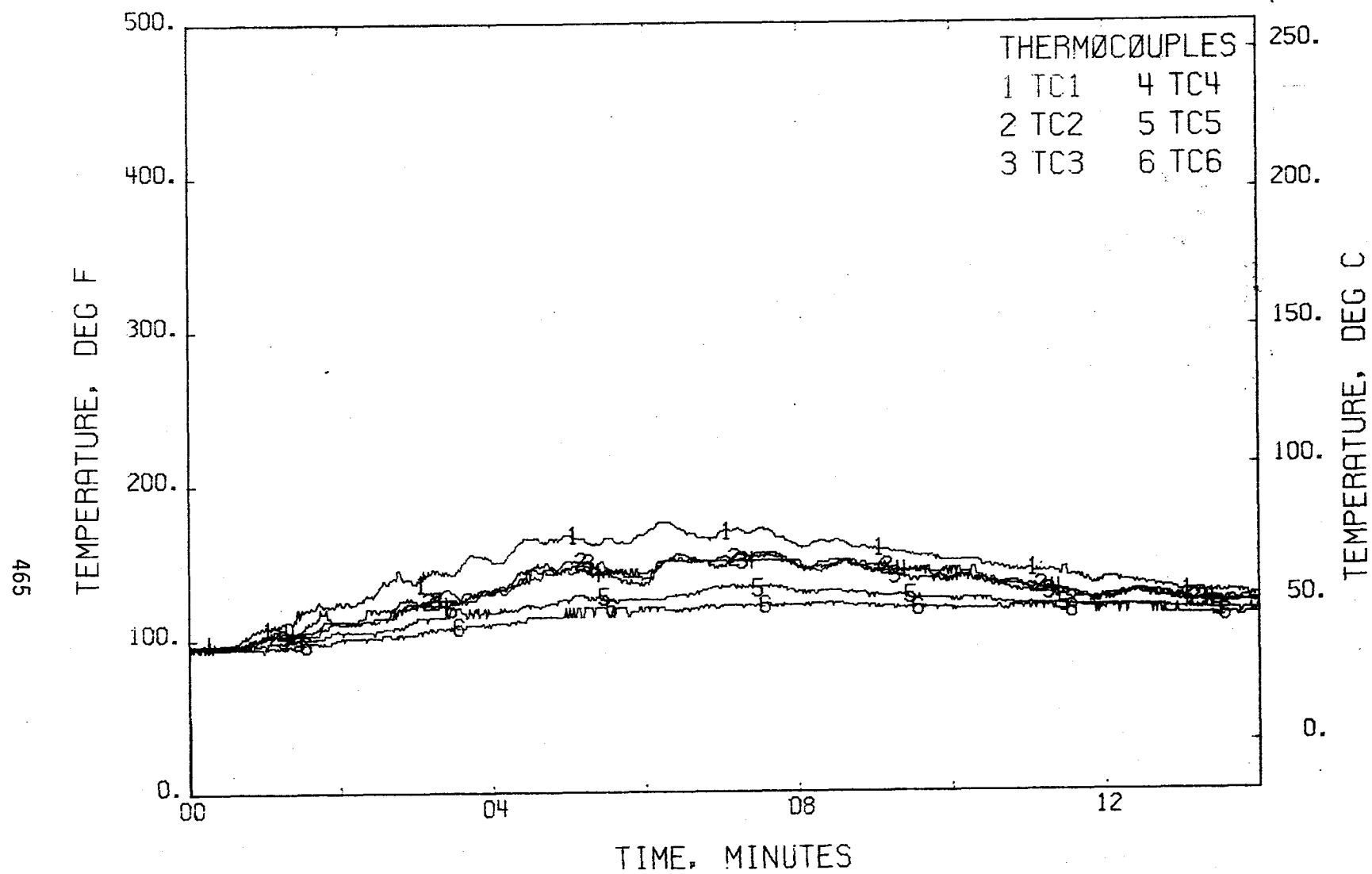


FIGURE 356 . - TEMPERATURES, T/C TREE 1  
TEST 18

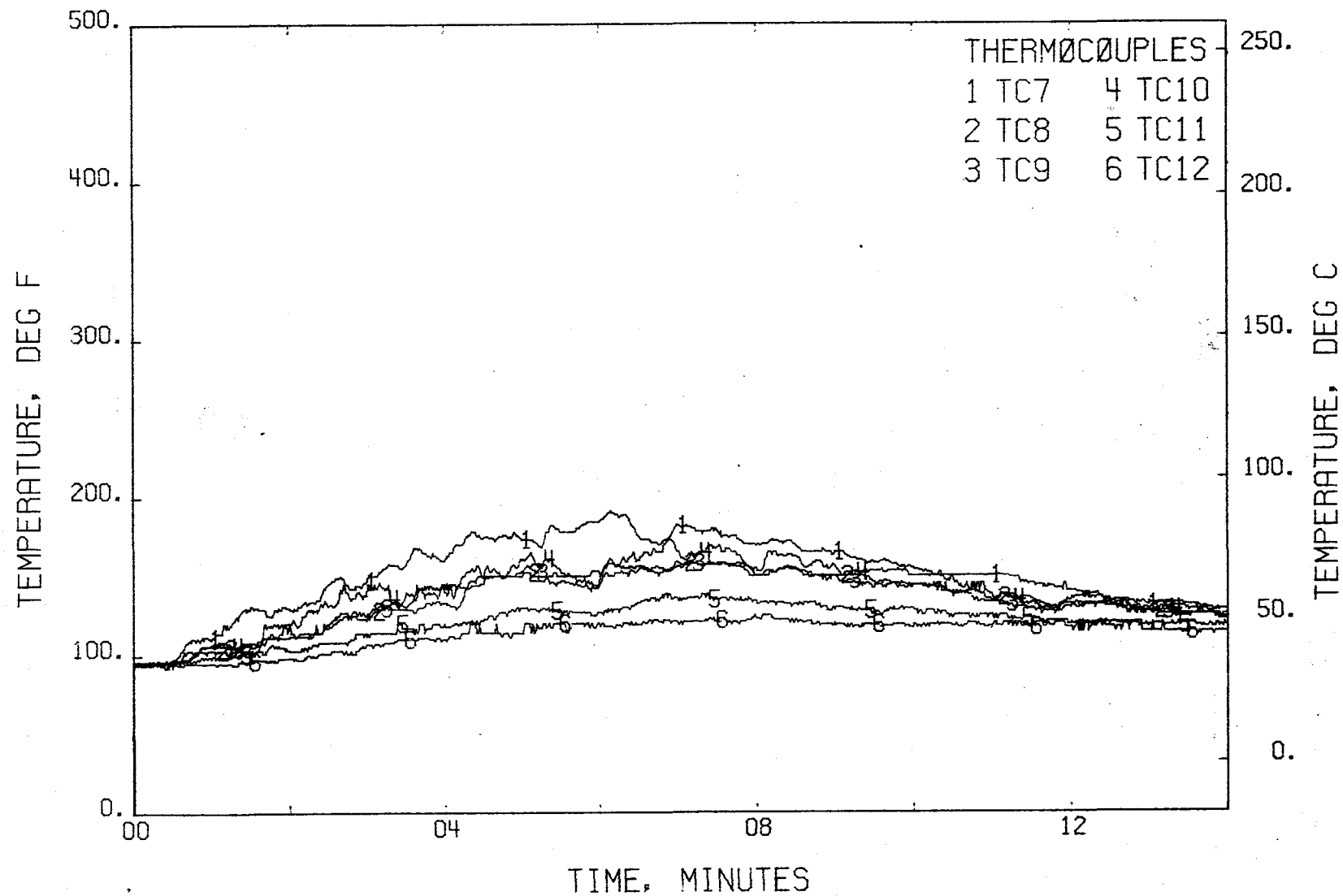


FIGURE 357 . - TEMPERATURES, T/C TREE 2  
TEST 18

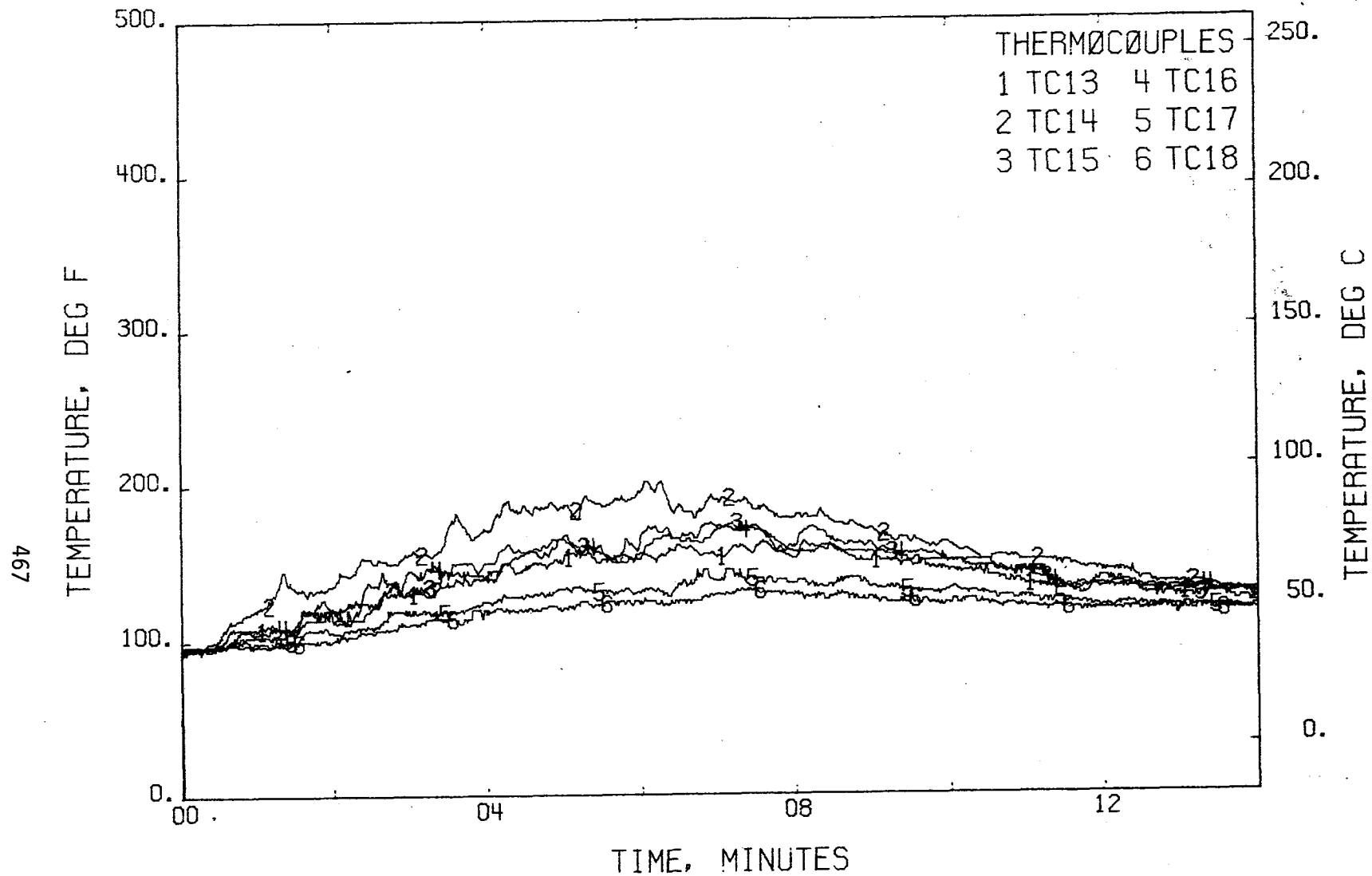


FIGURE 358 . - TEMPERATURES, T/C TREE 3  
TEST 18

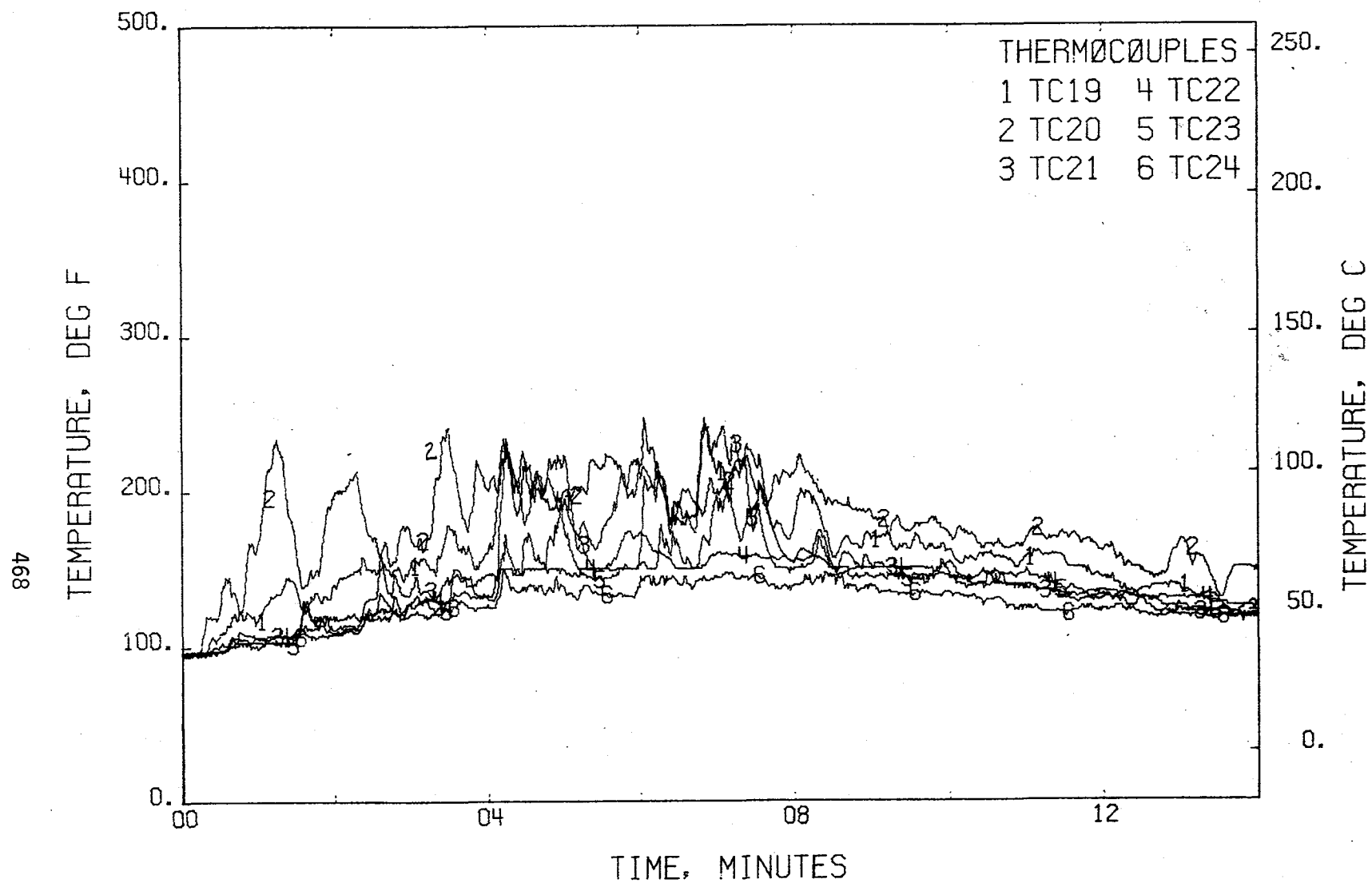


FIGURE 359 . - TEMPERATURES, T/C TREE 4  
TEST 18

469

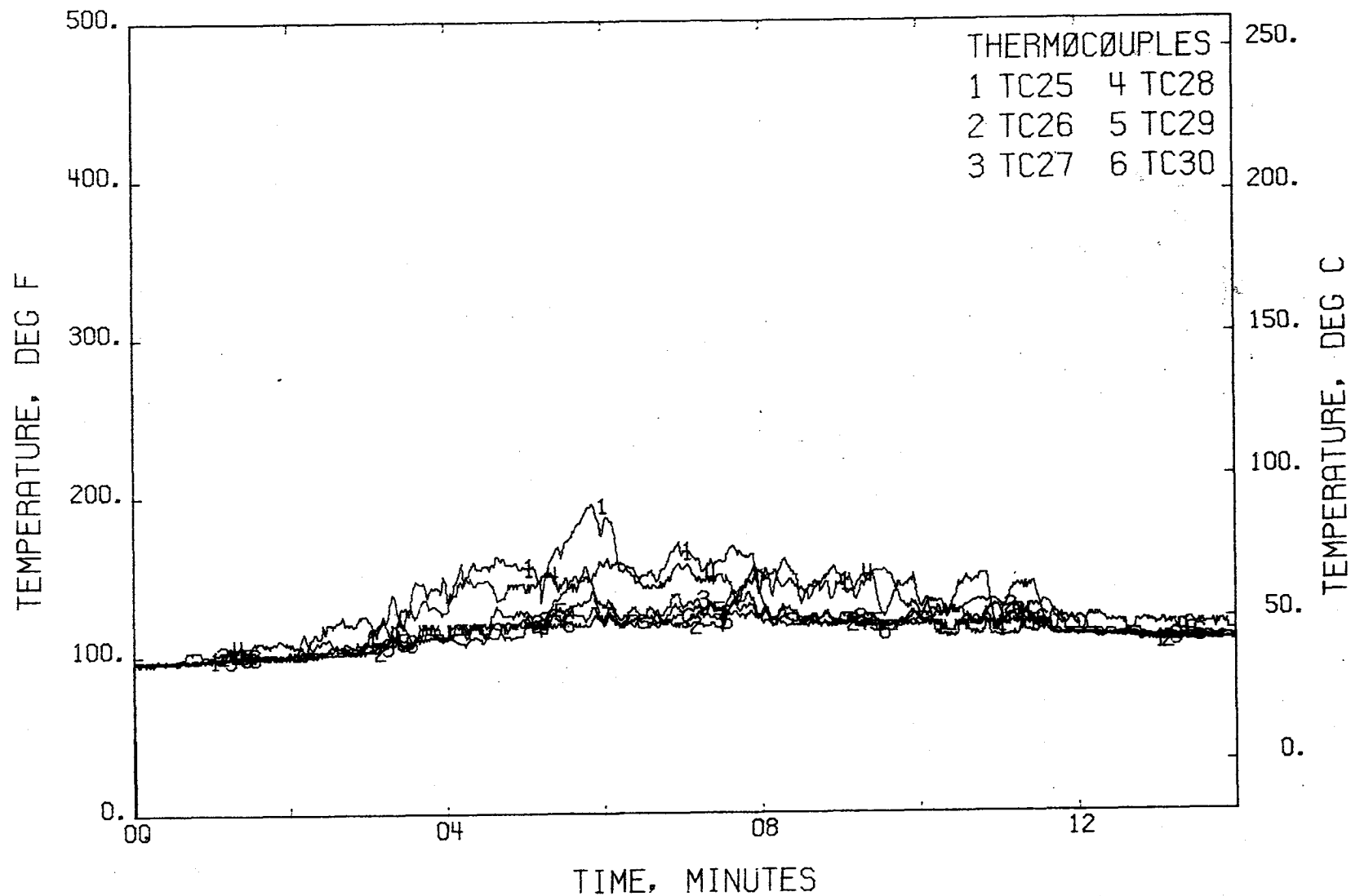


FIGURE 360 . - TEMPERATURES, T/C TREE 5  
TEST 18

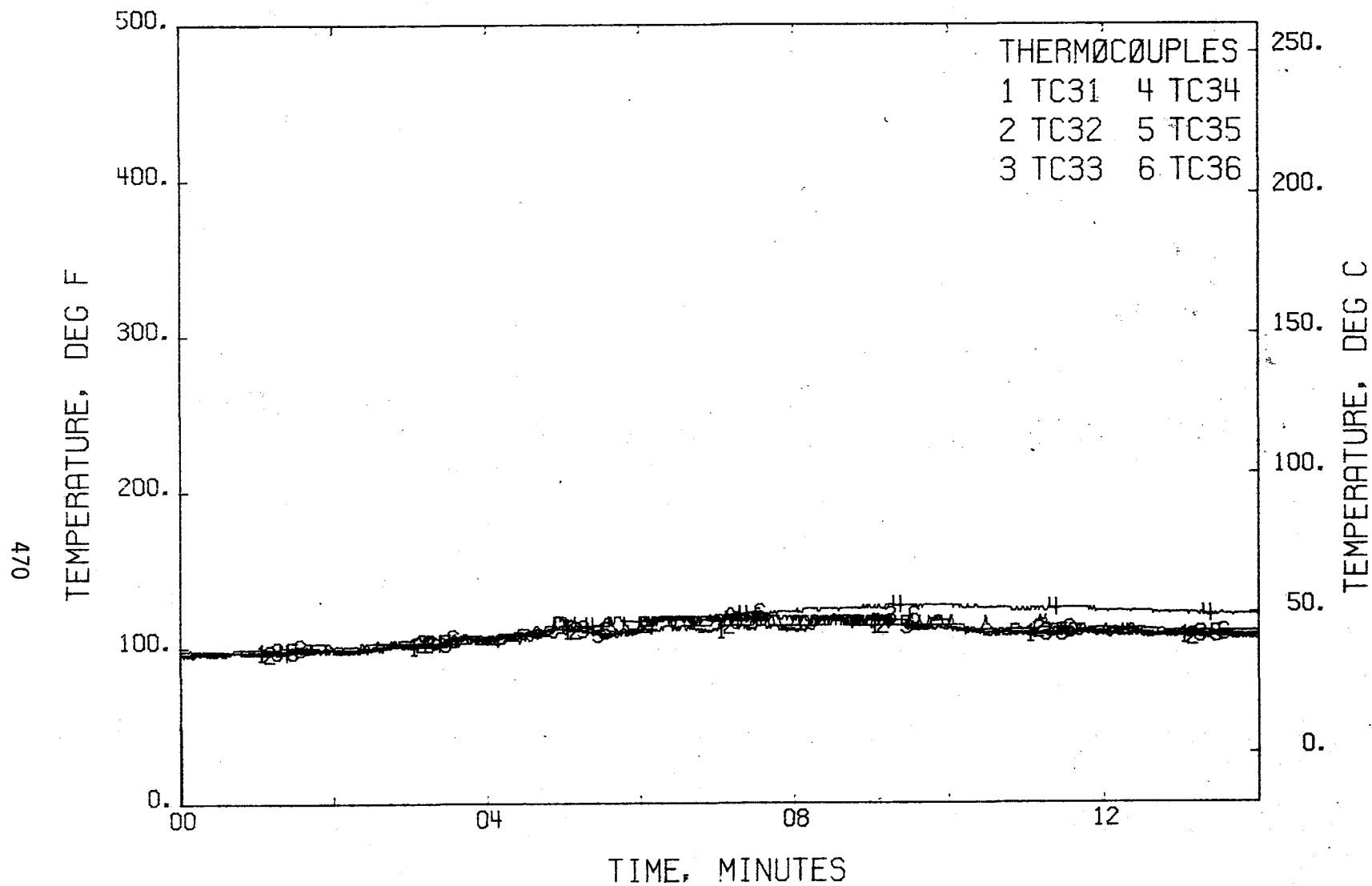


FIGURE 361 . - TEMPERATURES, T/C TREE 6  
TEST 18

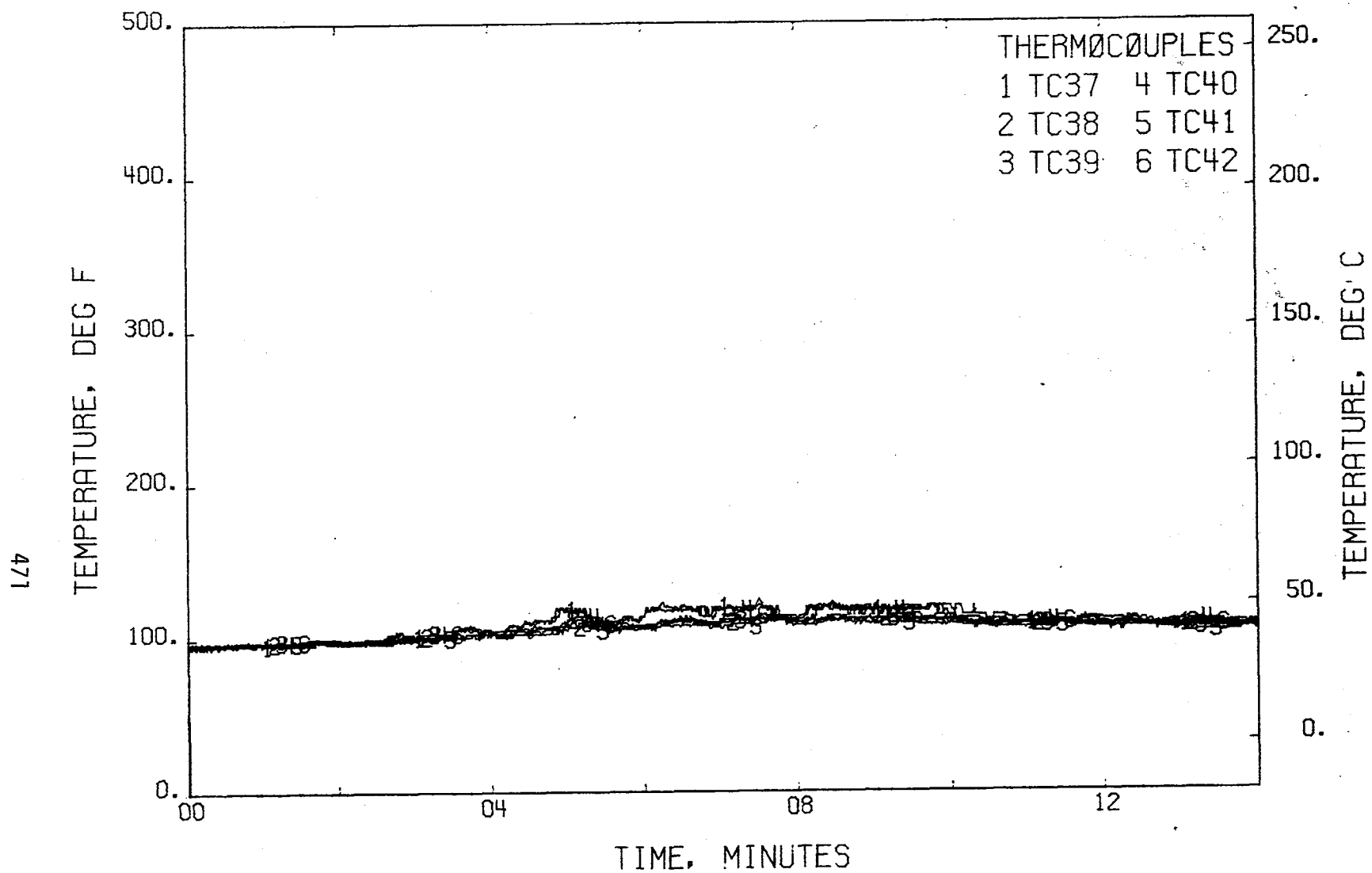


FIGURE 362 . - TEMPERATURES, T/C TREE 7  
TEST 18

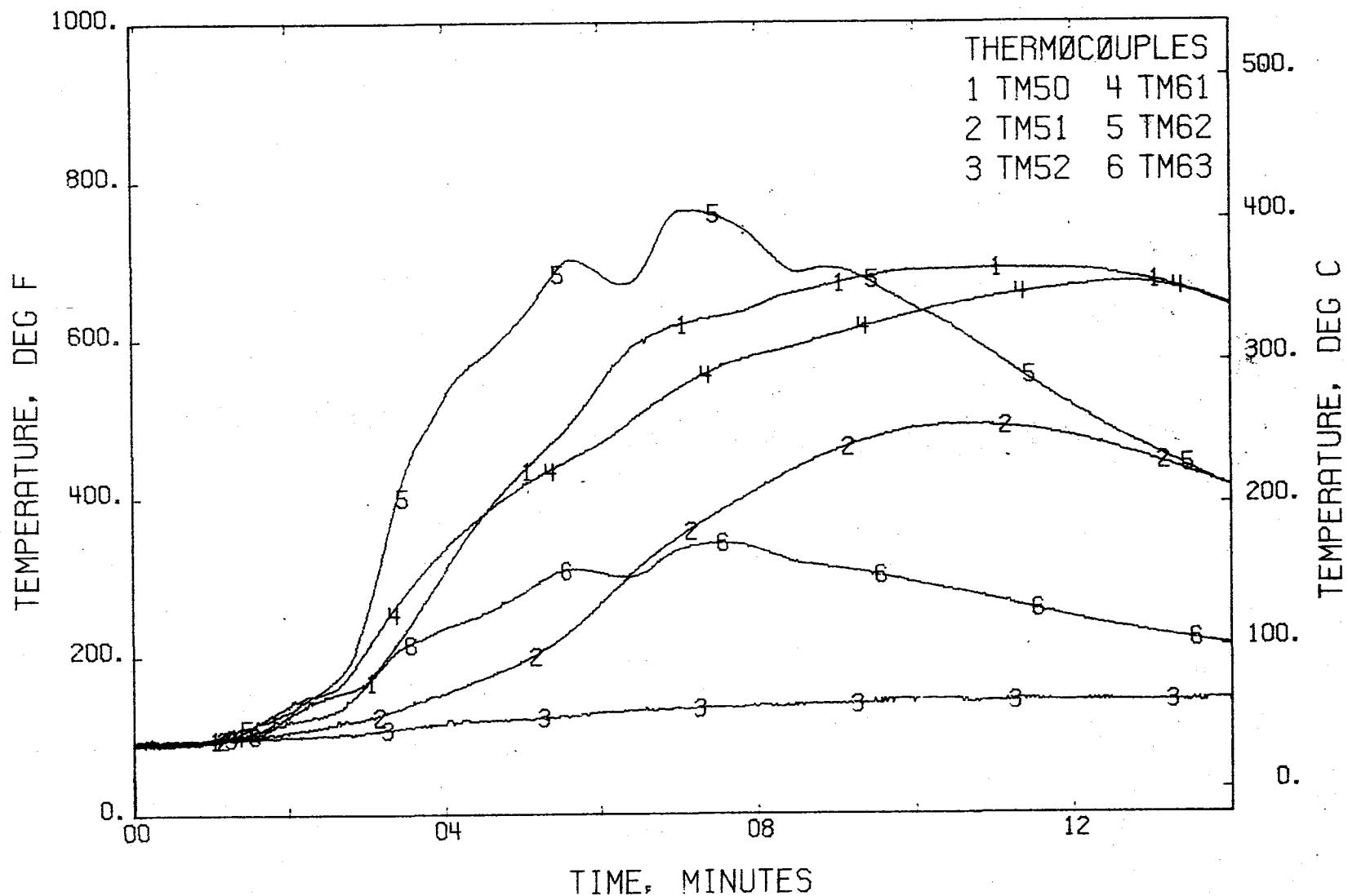


FIGURE 363 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 18



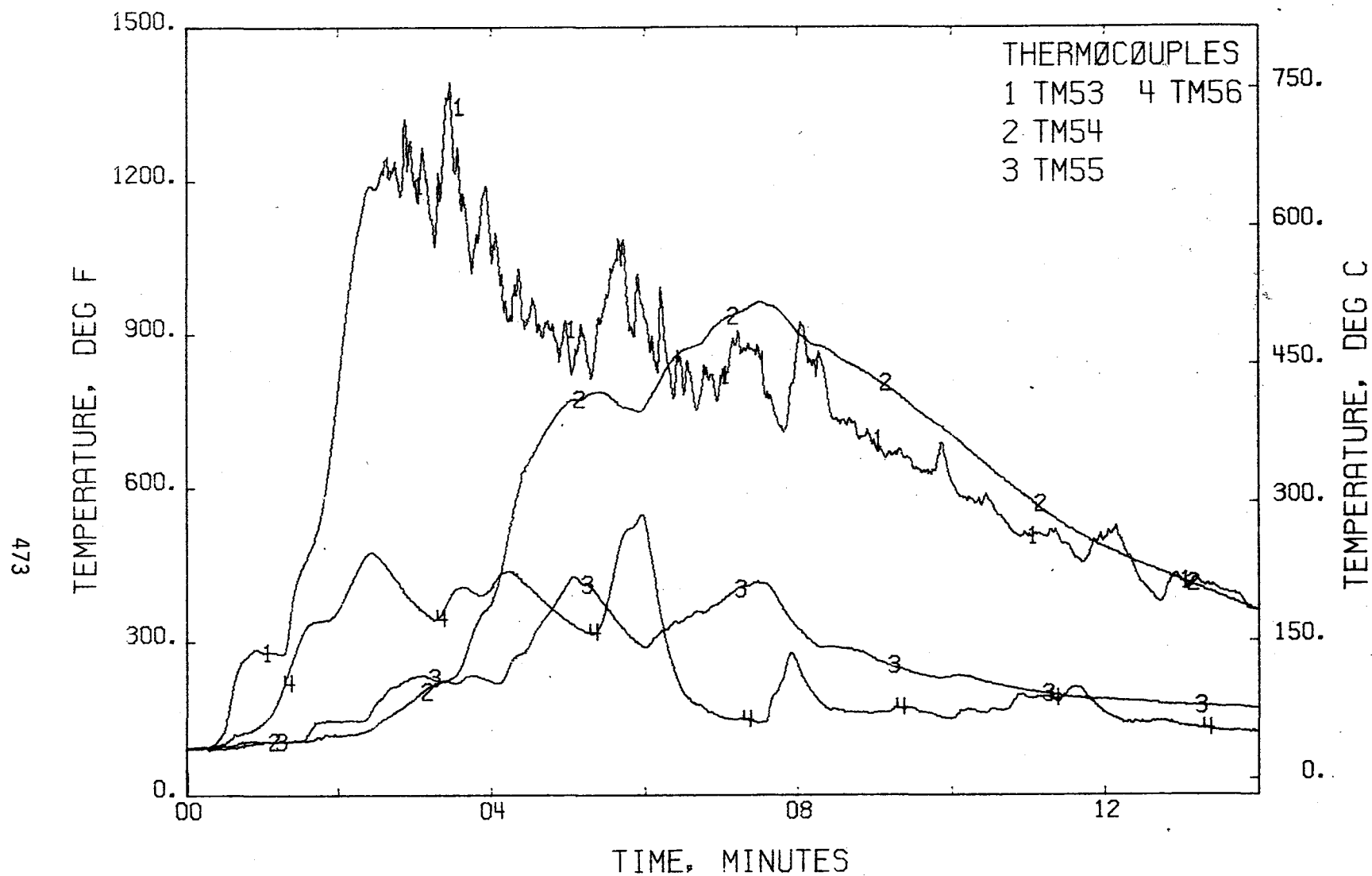


FIGURE 364 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 18

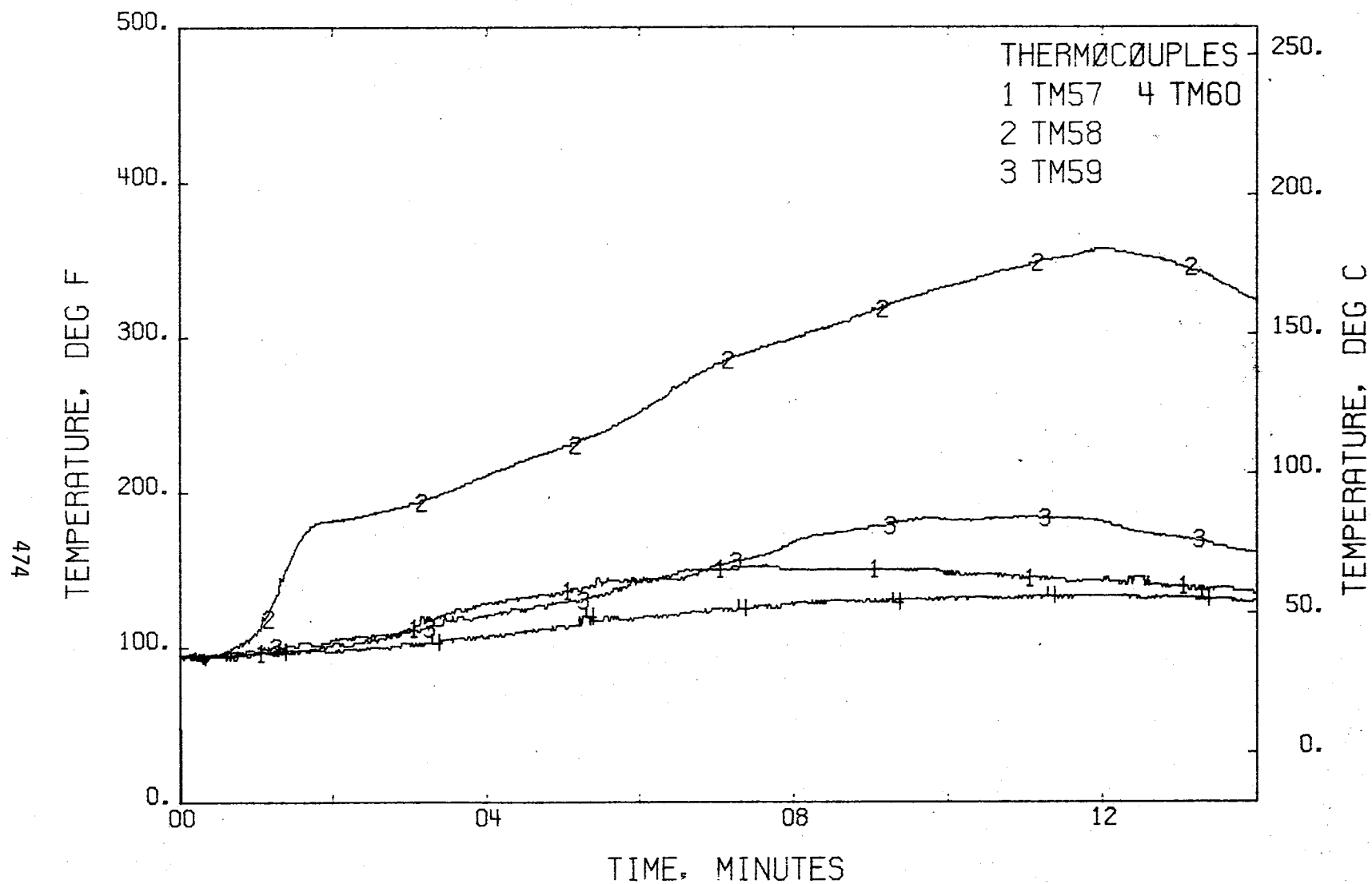


FIGURE 364 . - TEMPERATURES, SEAT CUSHIONS (EDGES) - CONT.  
TEST 18

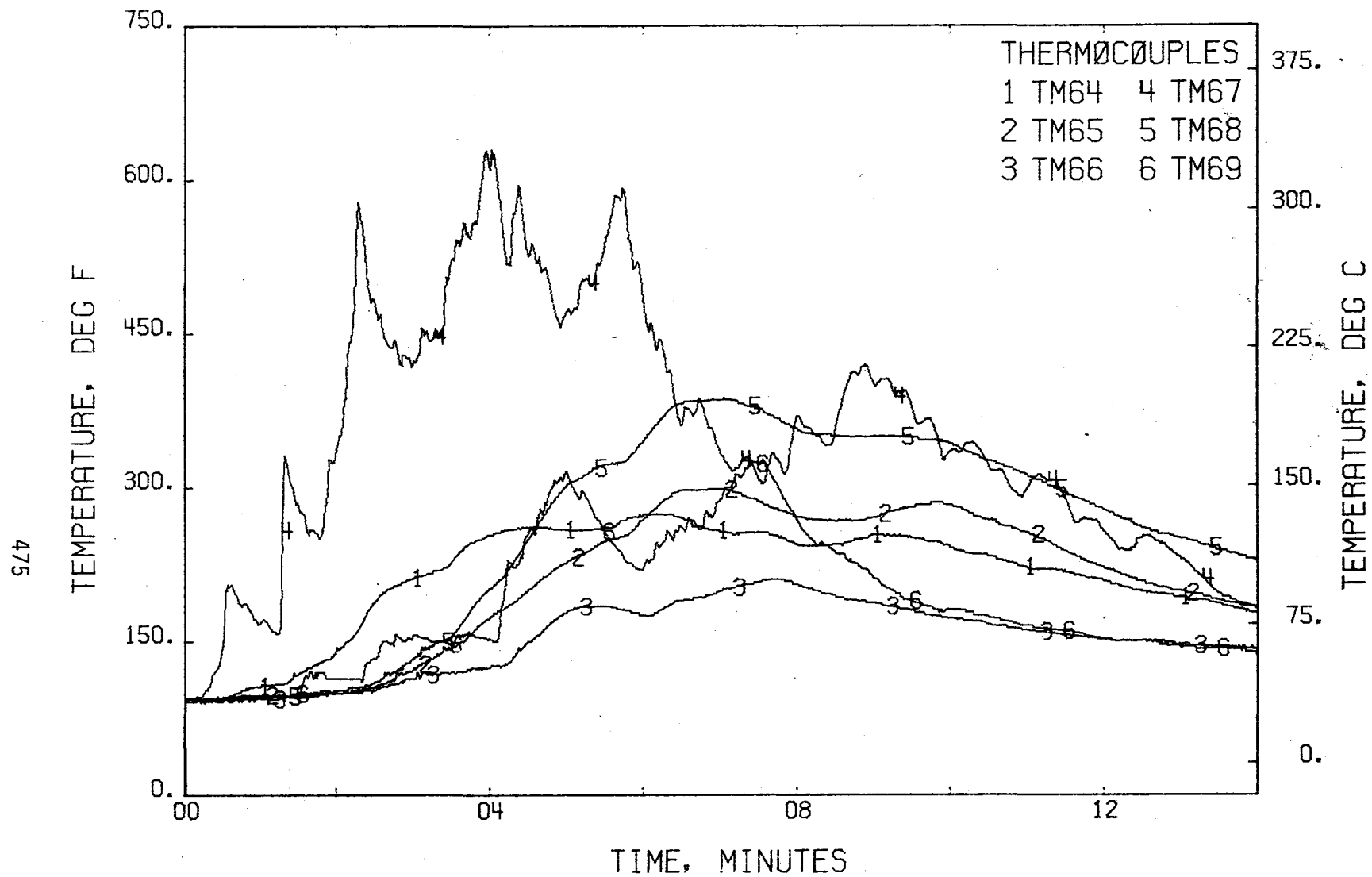


FIGURE 365 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 18

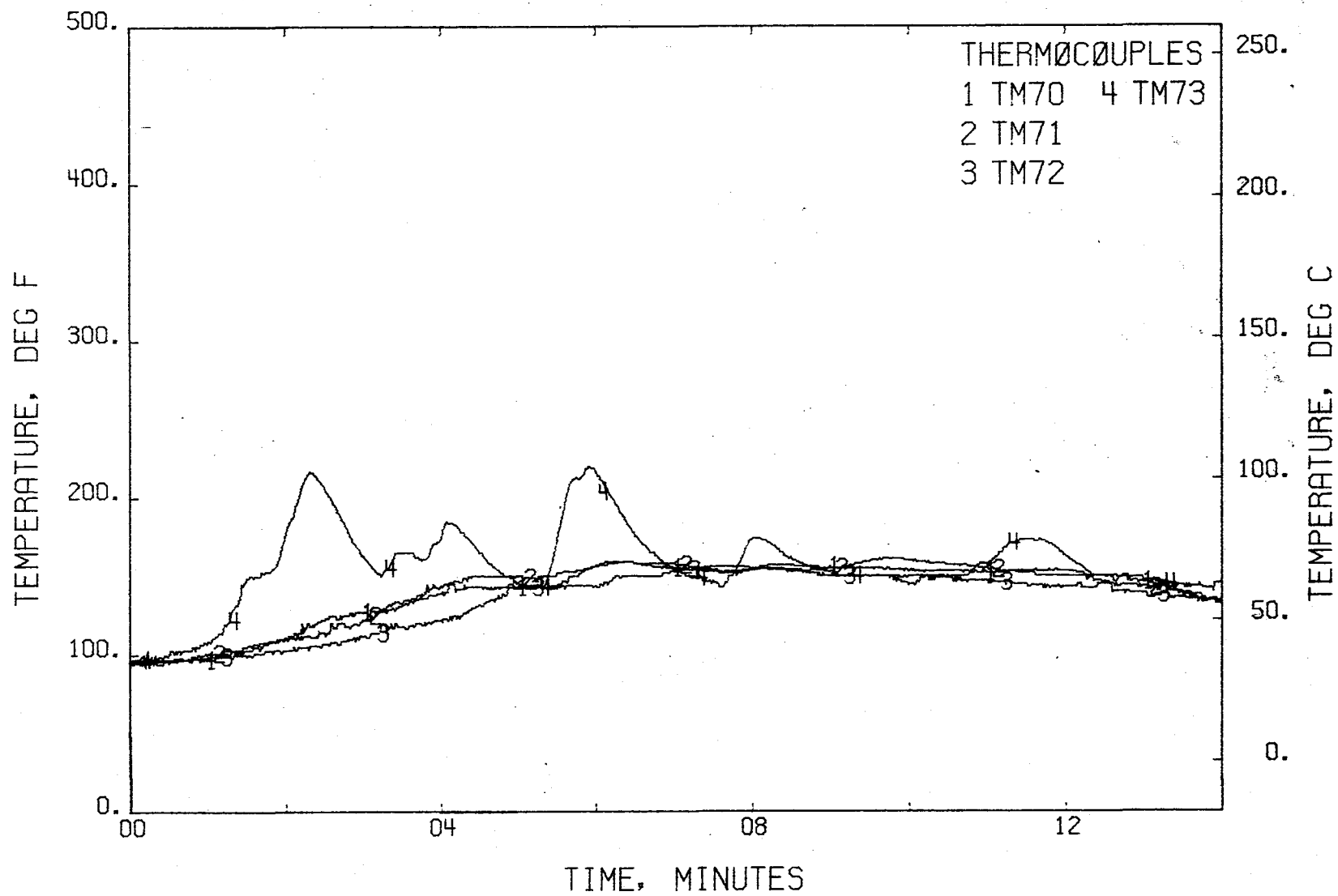


FIGURE 366 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 18

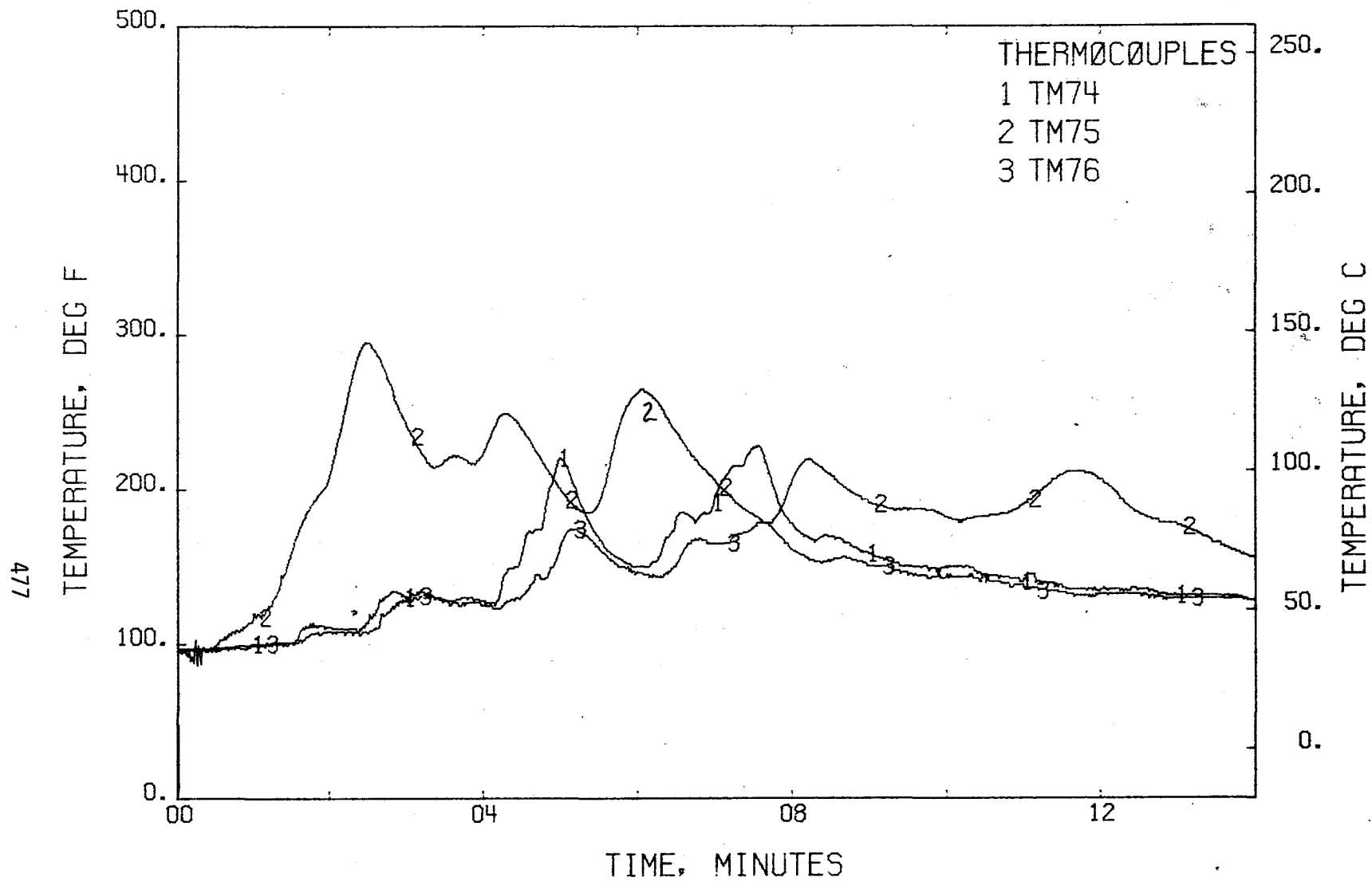


FIGURE 366 . - TEMPERATURES, SEAT BACK (EDGES)-CONT.  
TEST 18

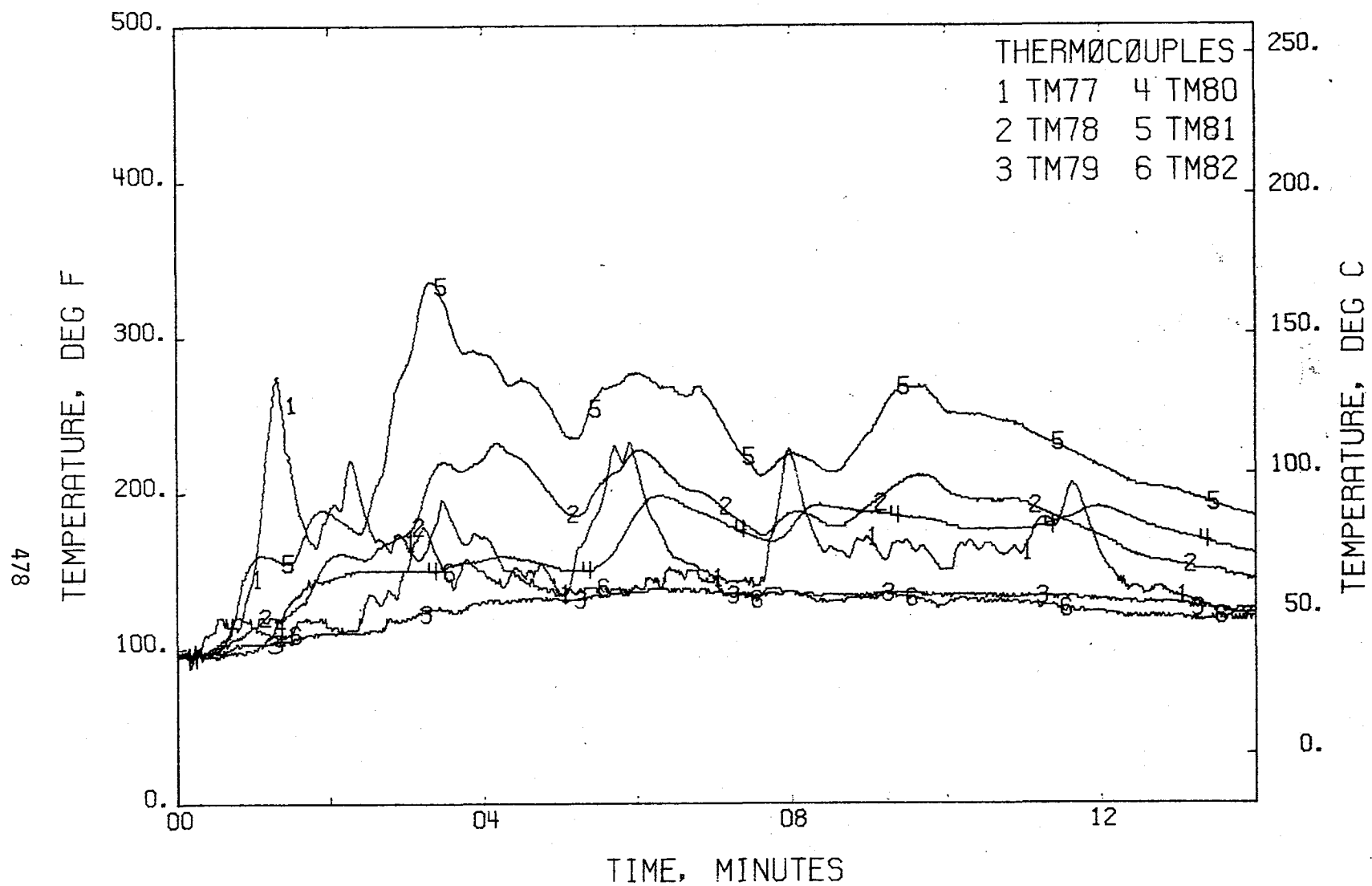


FIGURE 367 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 18

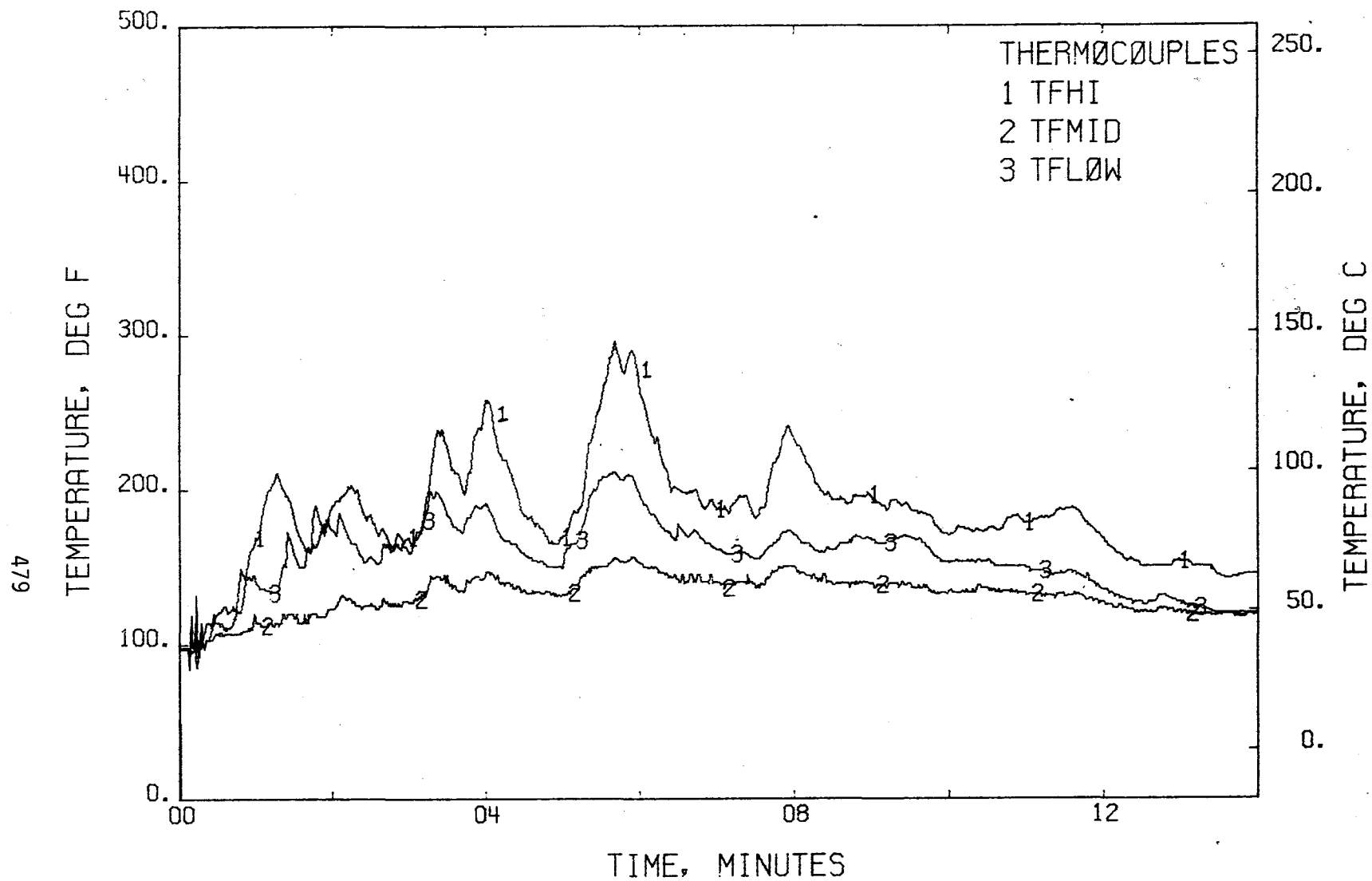


FIGURE 368 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 18

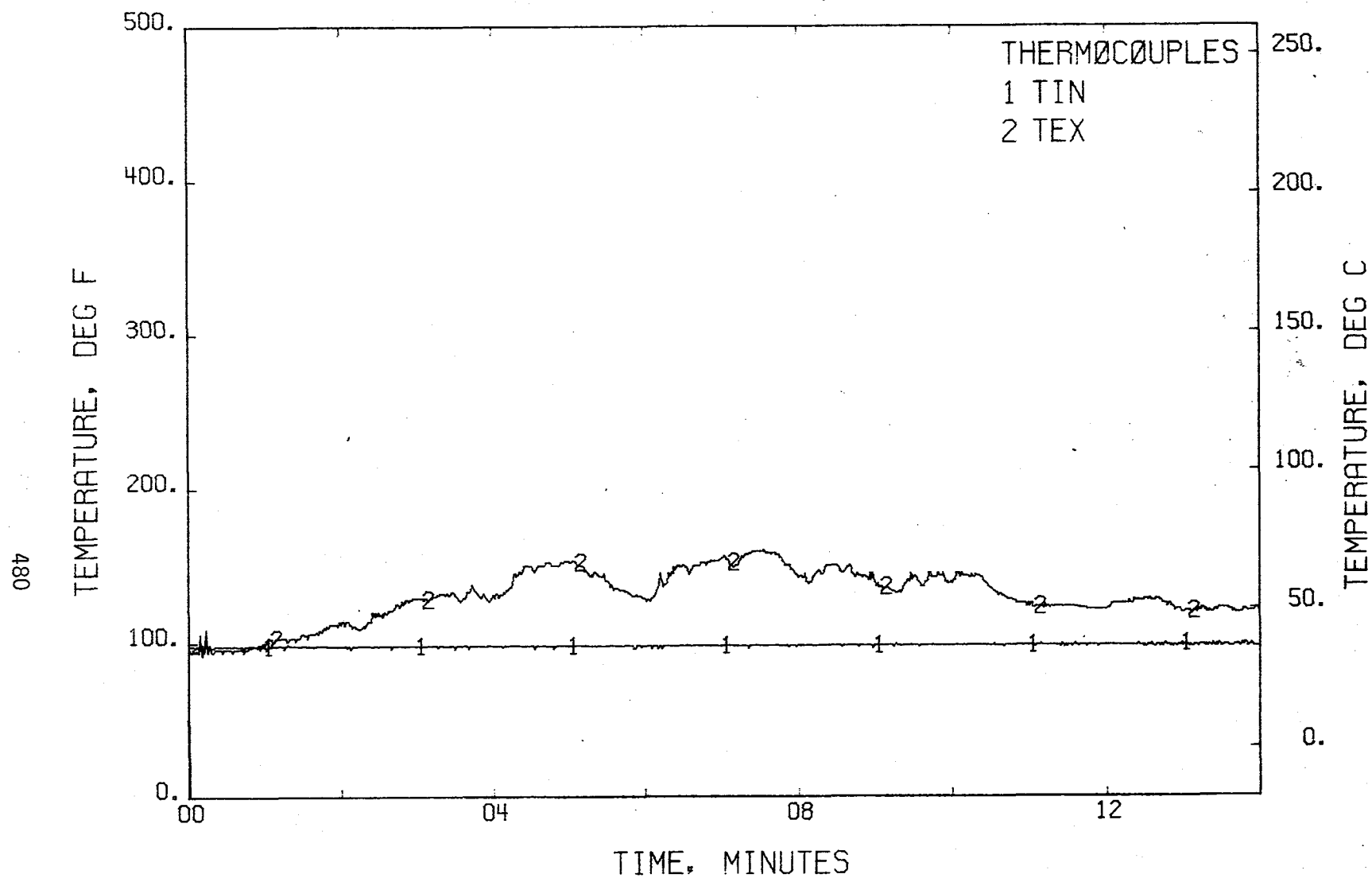


FIGURE 369 . - TEMPERATURES, INLET + EXIT  
TEST 18



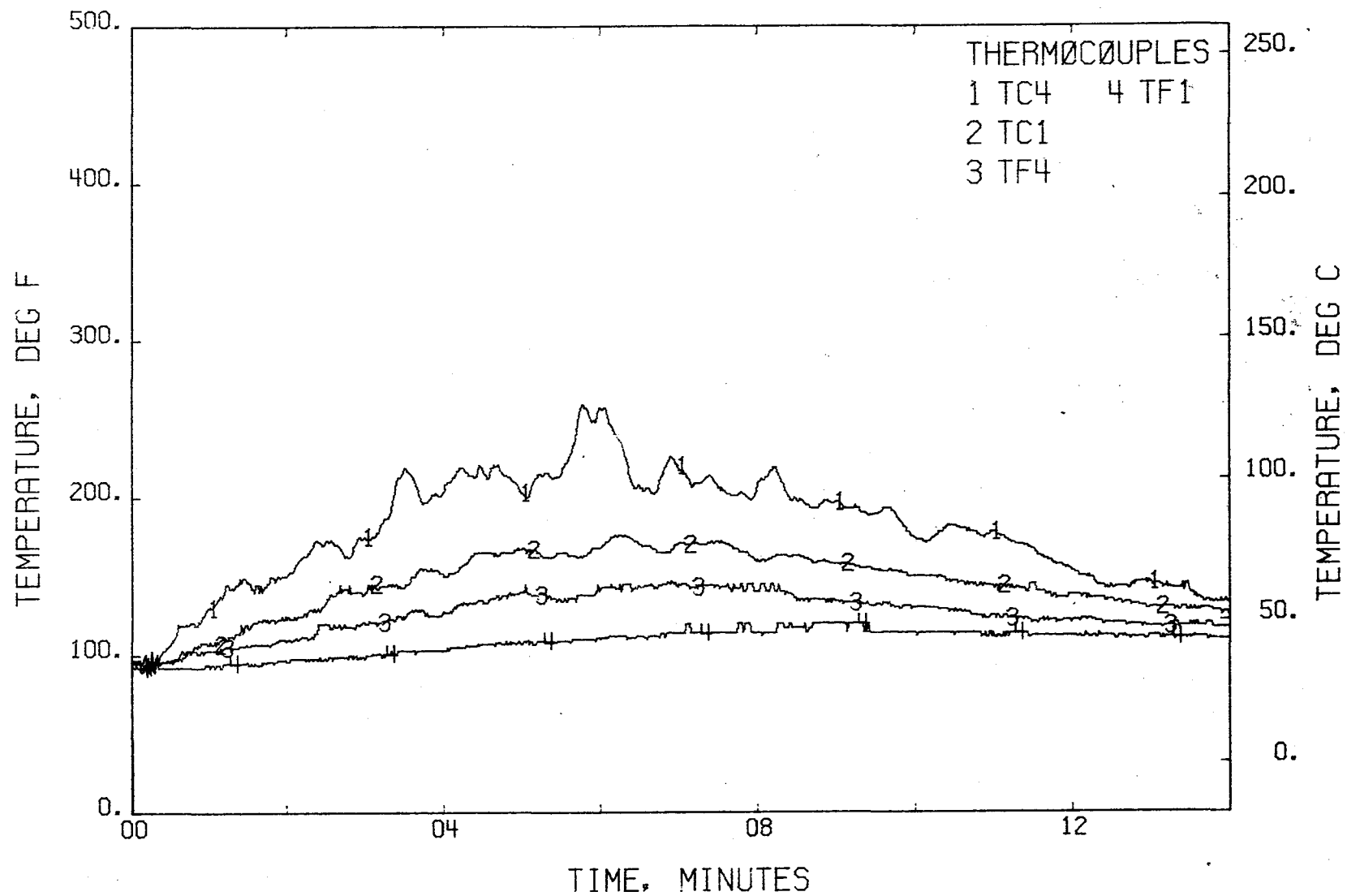


FIGURE 370 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 18

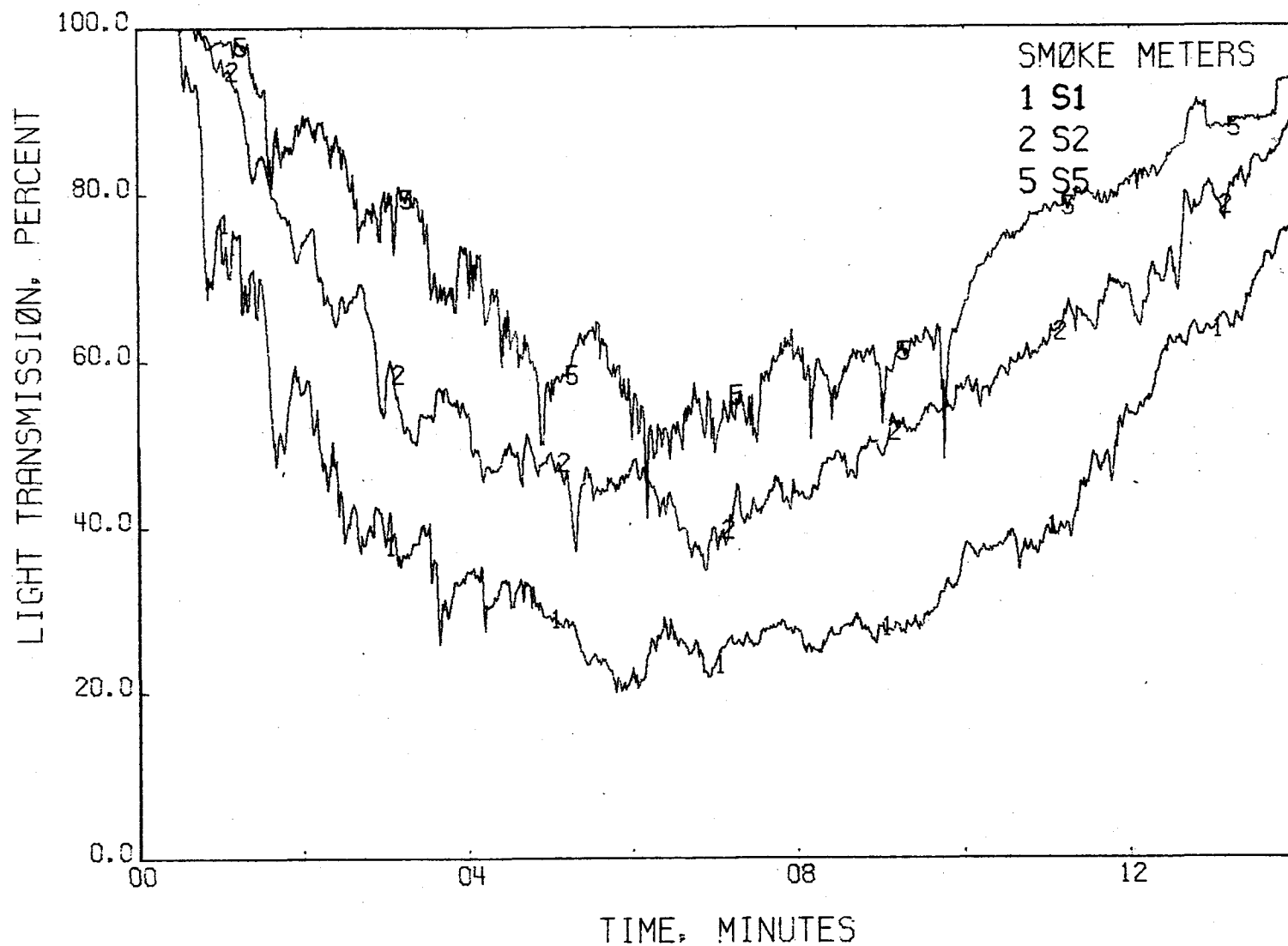


FIGURE 371 . - LIGHT TRANSMISSION  
TEST 18

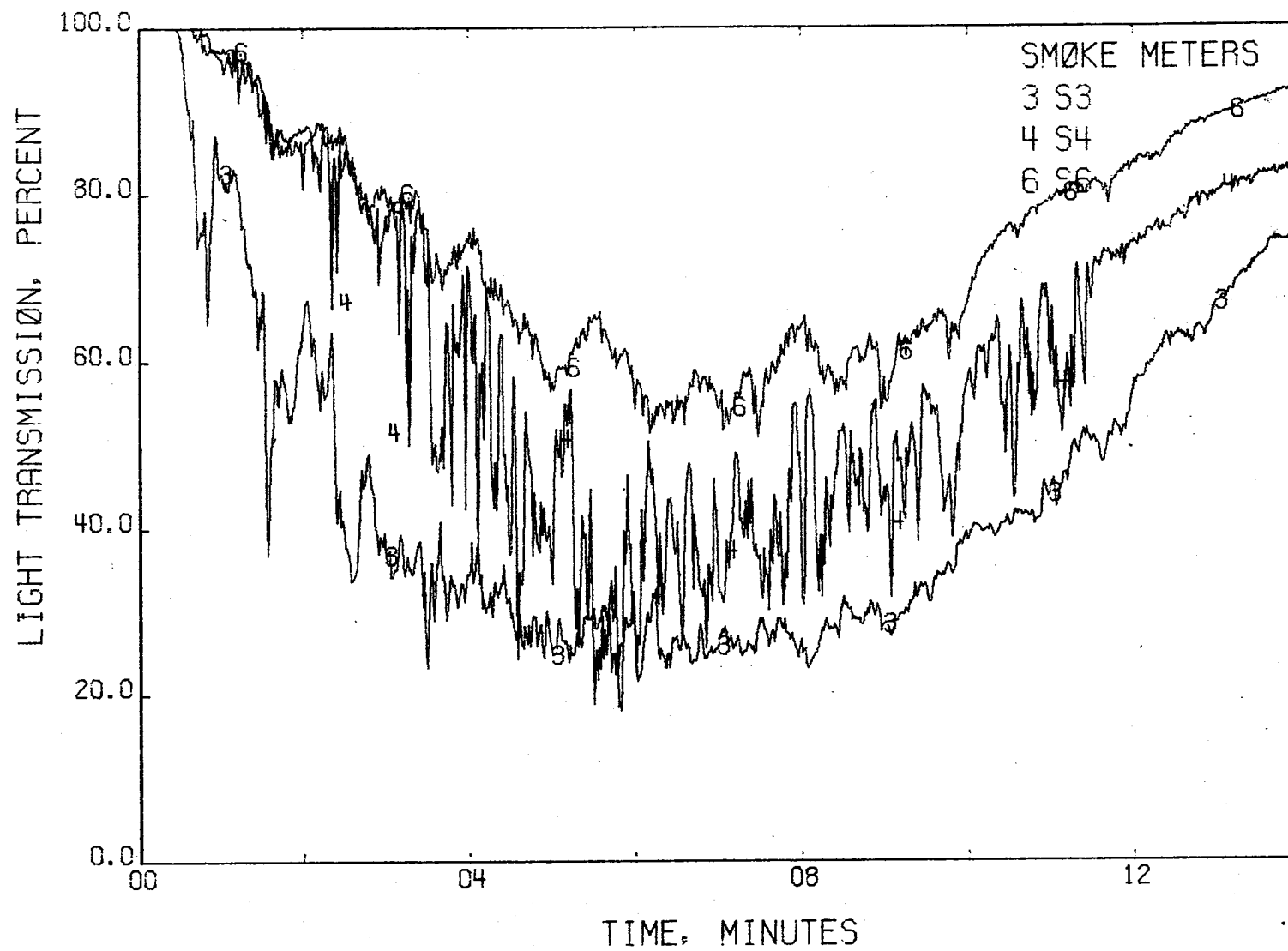
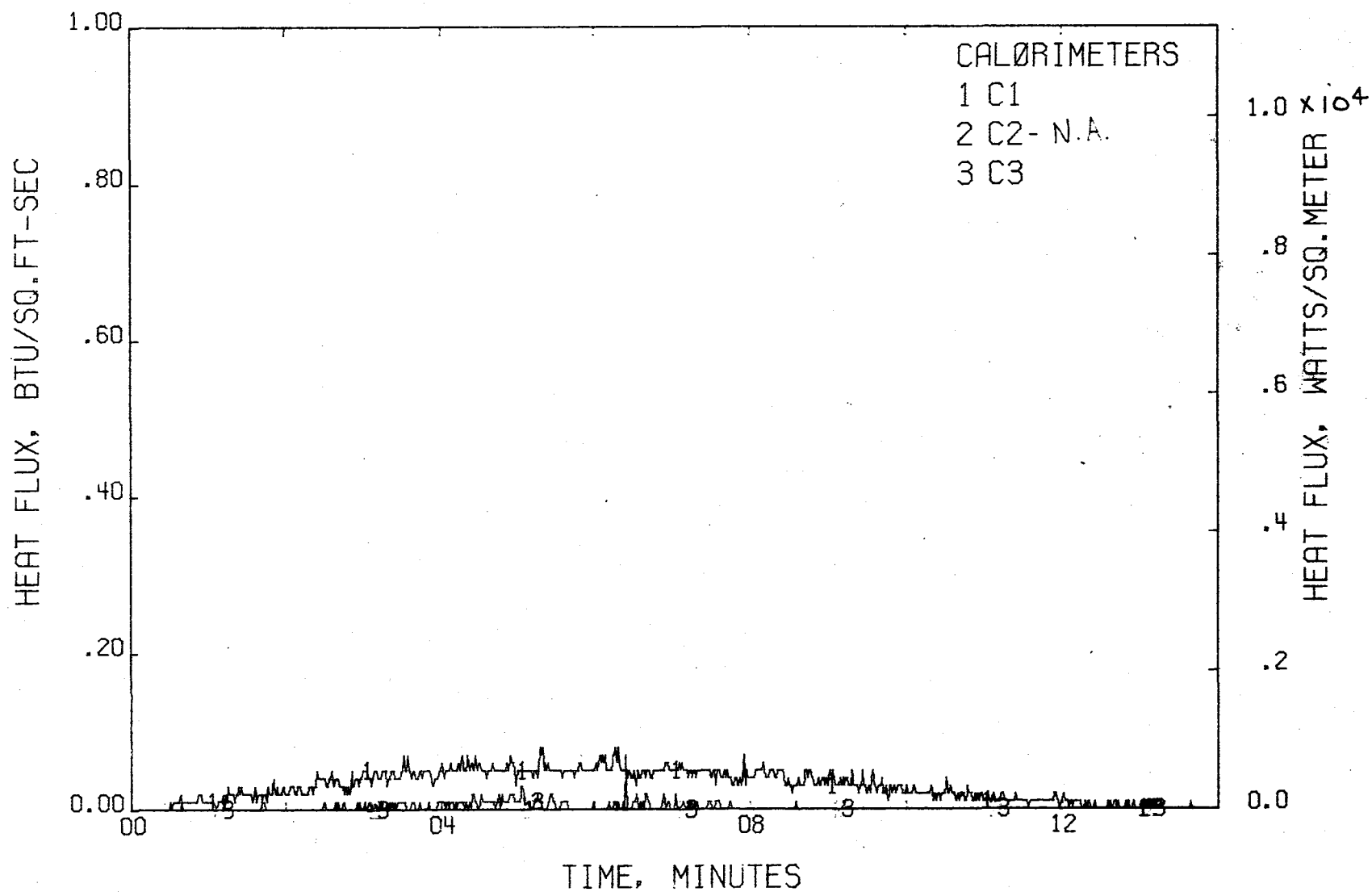


FIGURE 371 . - LIGHT TRANSMISSION - CONT.  
TEST 18

484



485

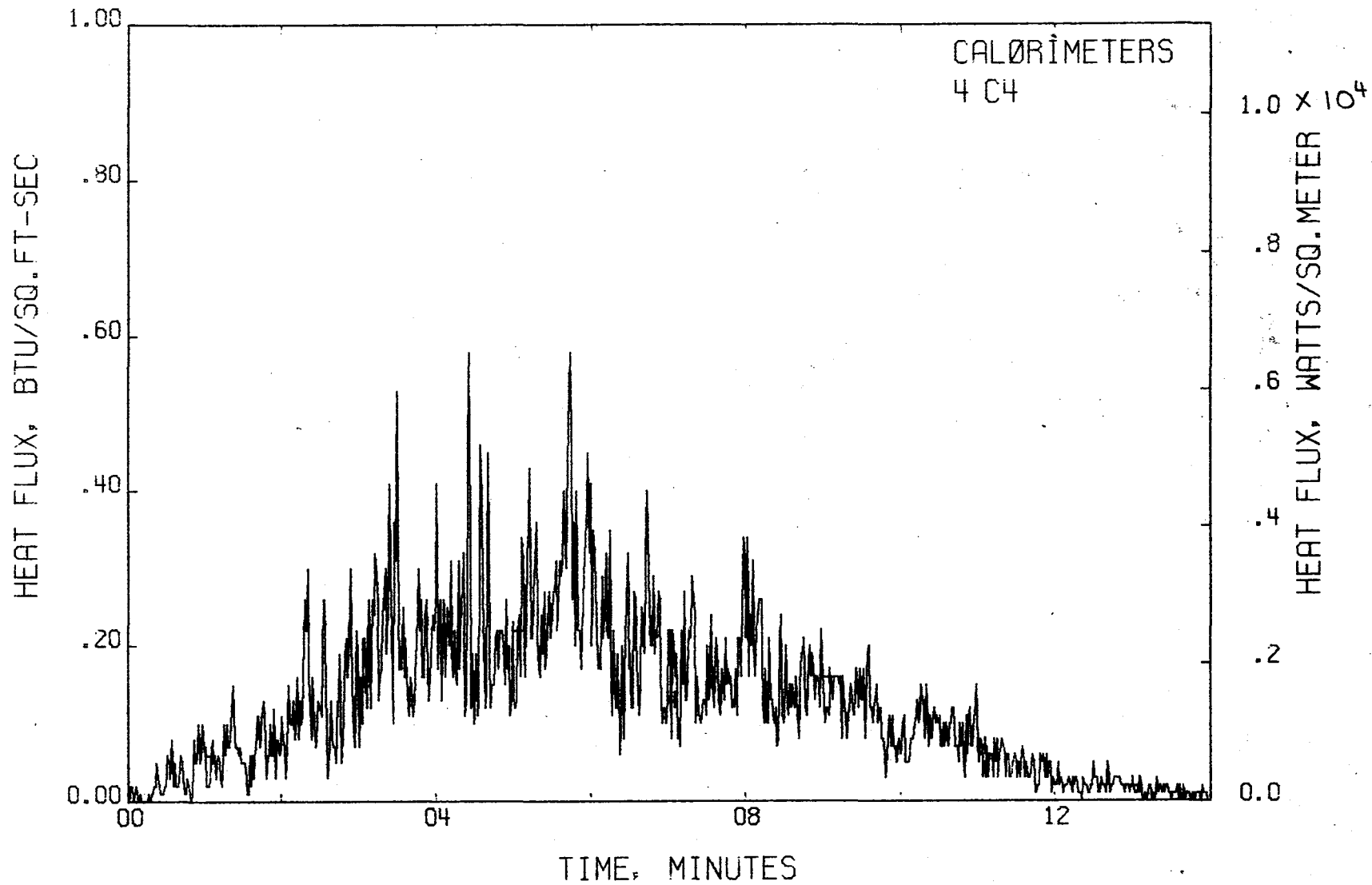


FIGURE 373 . - HEAT FLUX, MIDSECTION  
TEST 18

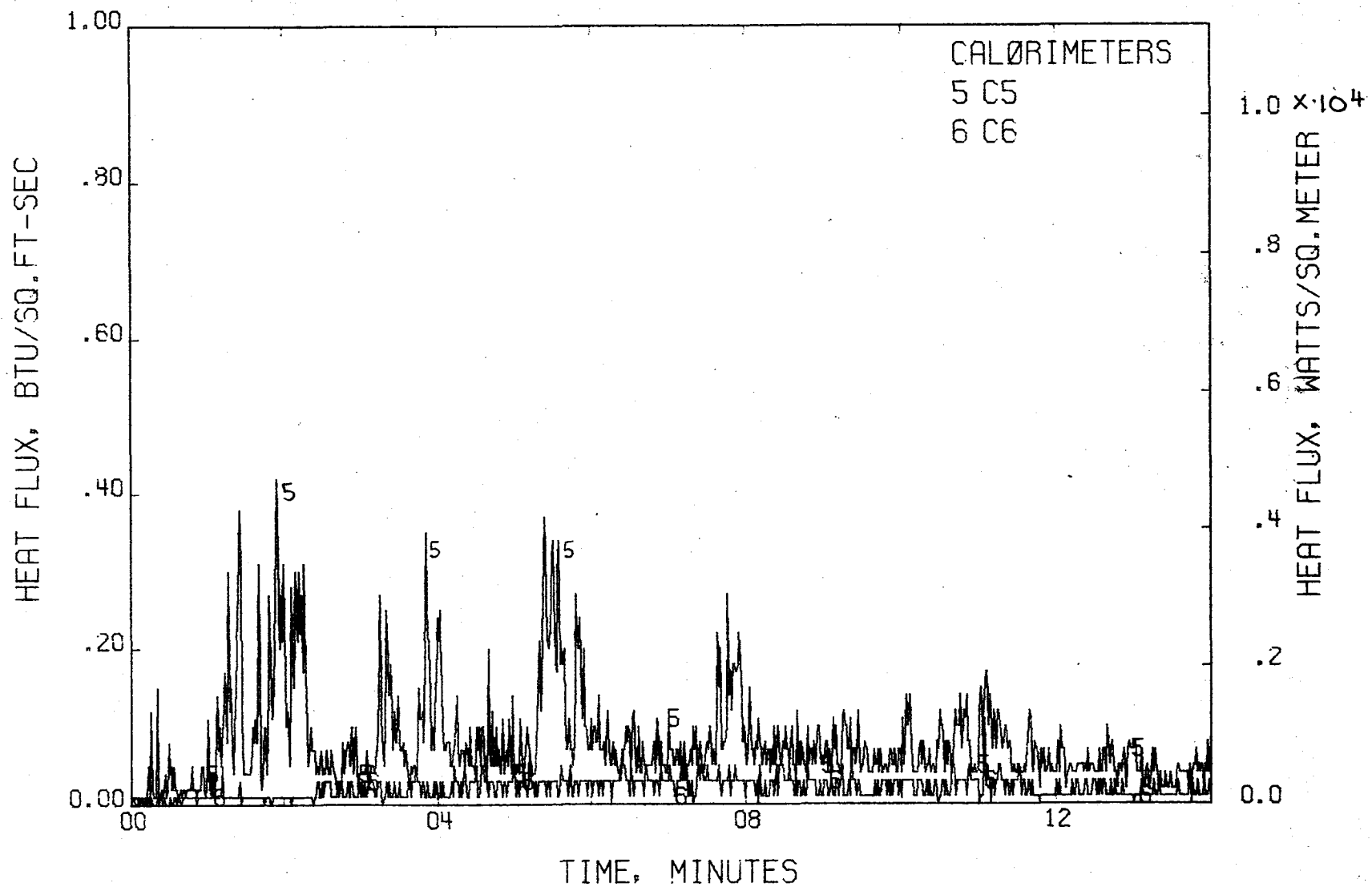


FIGURE 373 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 18

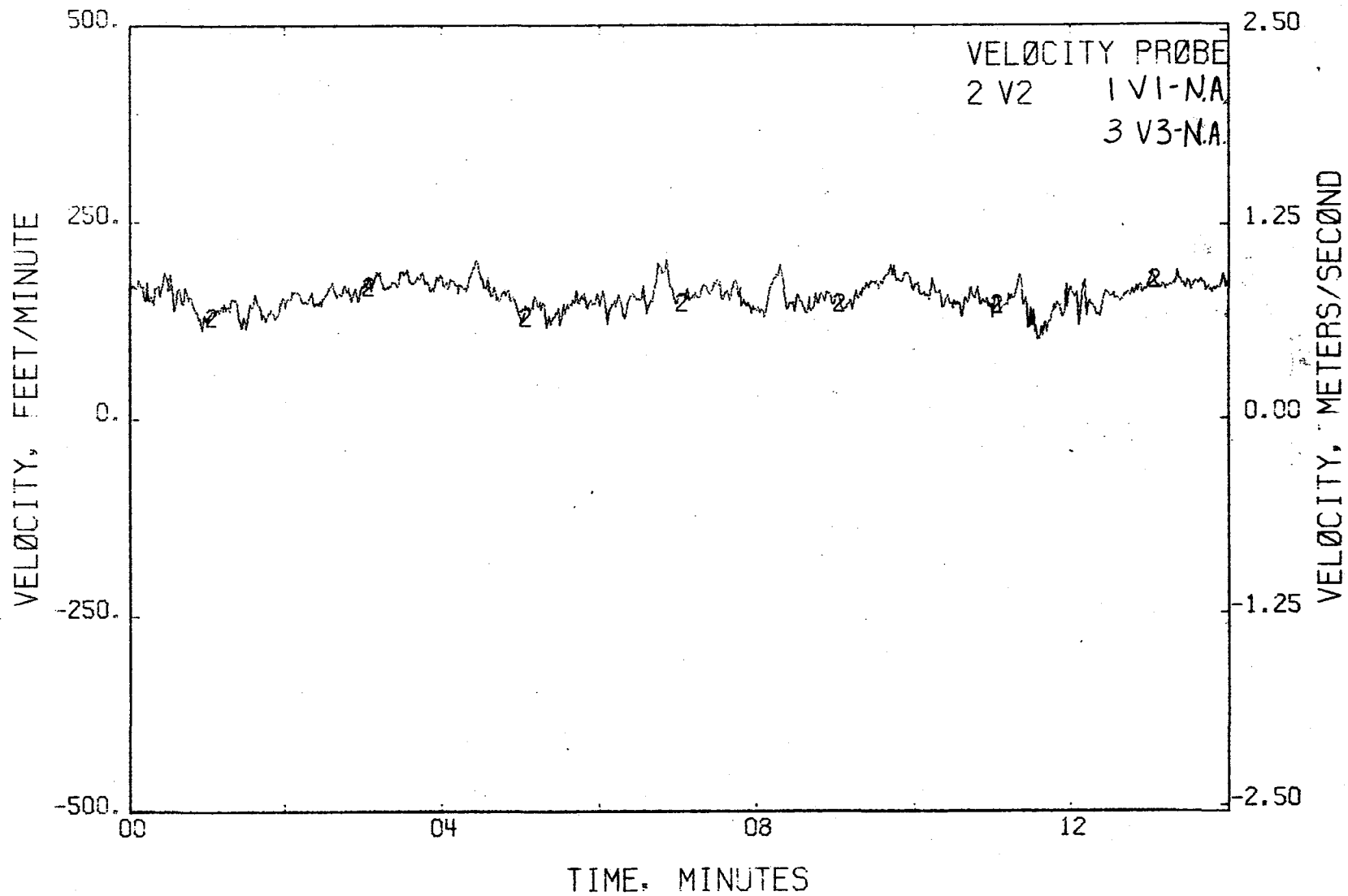


FIGURE 374 . - AIR VELOCITY  
TEST 18

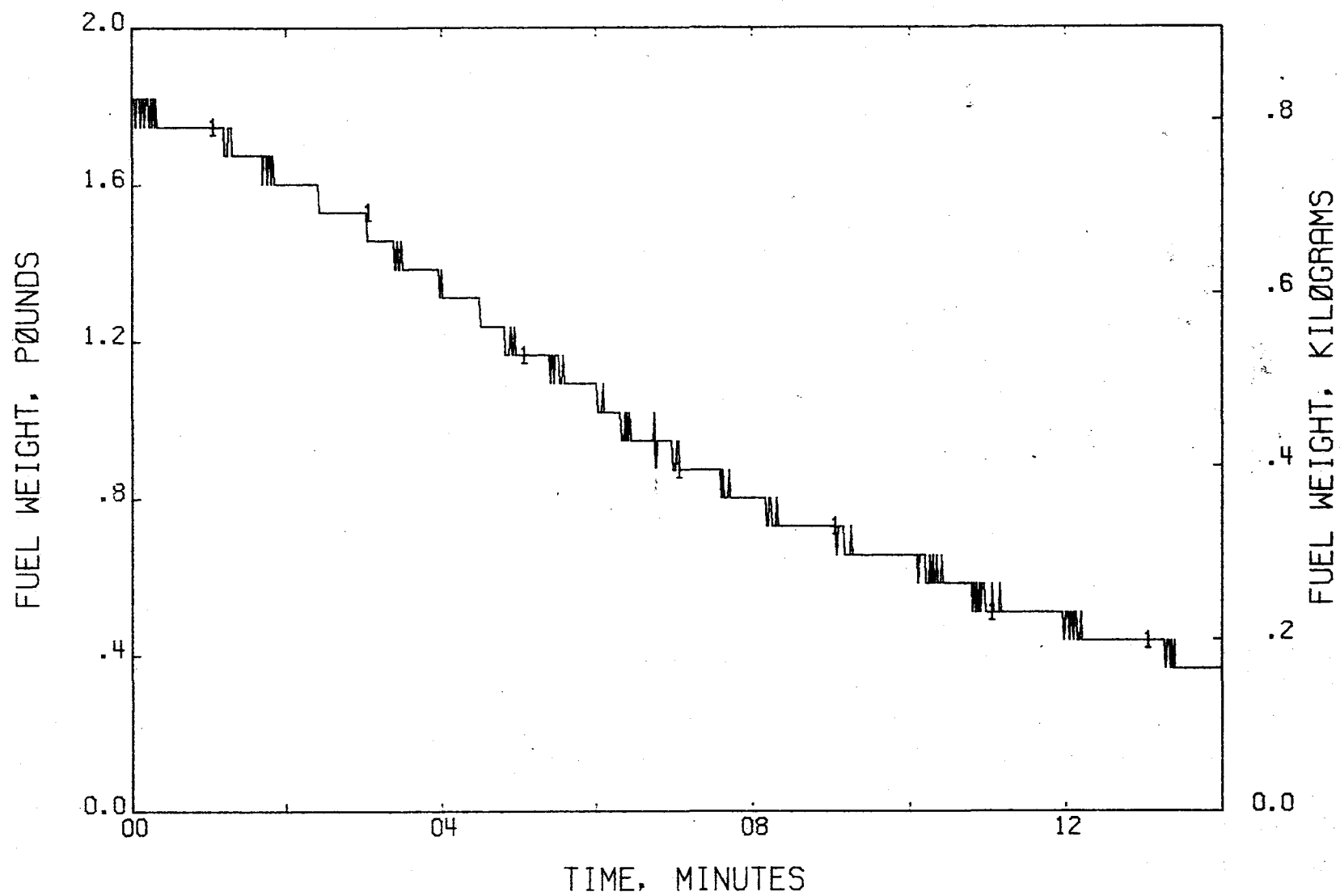


FIGURE 375 . - FUEL WEIGHT LOSS  
TEST 18



489

SEAT WEIGHT, POUNDS

10.0  
8.0  
6.0  
4.0  
2.0  
0.0

00

04

08

12

TIMES, MINUTES

4.0

3.0

2.0

1.0

0.0

SEAT WEIGHT, KILOGRAMS

DATA NOT AVAILABLE

SEAT WEIGHT LOSS  
TEST 18

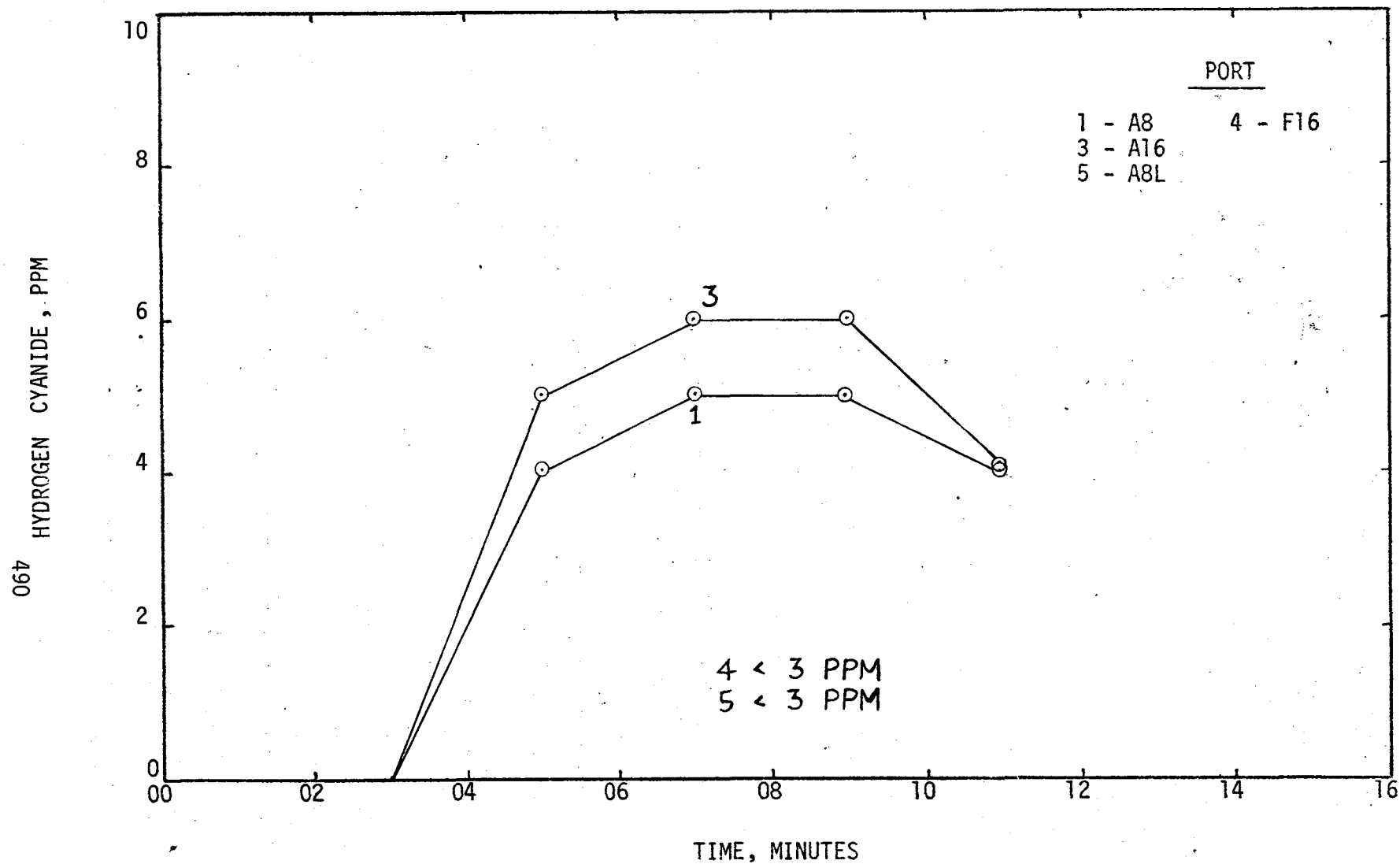


FIGURE 376 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 18

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN FLUORIDE - < 3 PPM

HYDROGEN CHLORIDE - < 6 PPM

491

FIGURE 377 . - HYDROGEN FLUORIDE AND CHLORIDE CONCENTRATIONS  
TEST 18

CARBON MONOXIDE, PPM

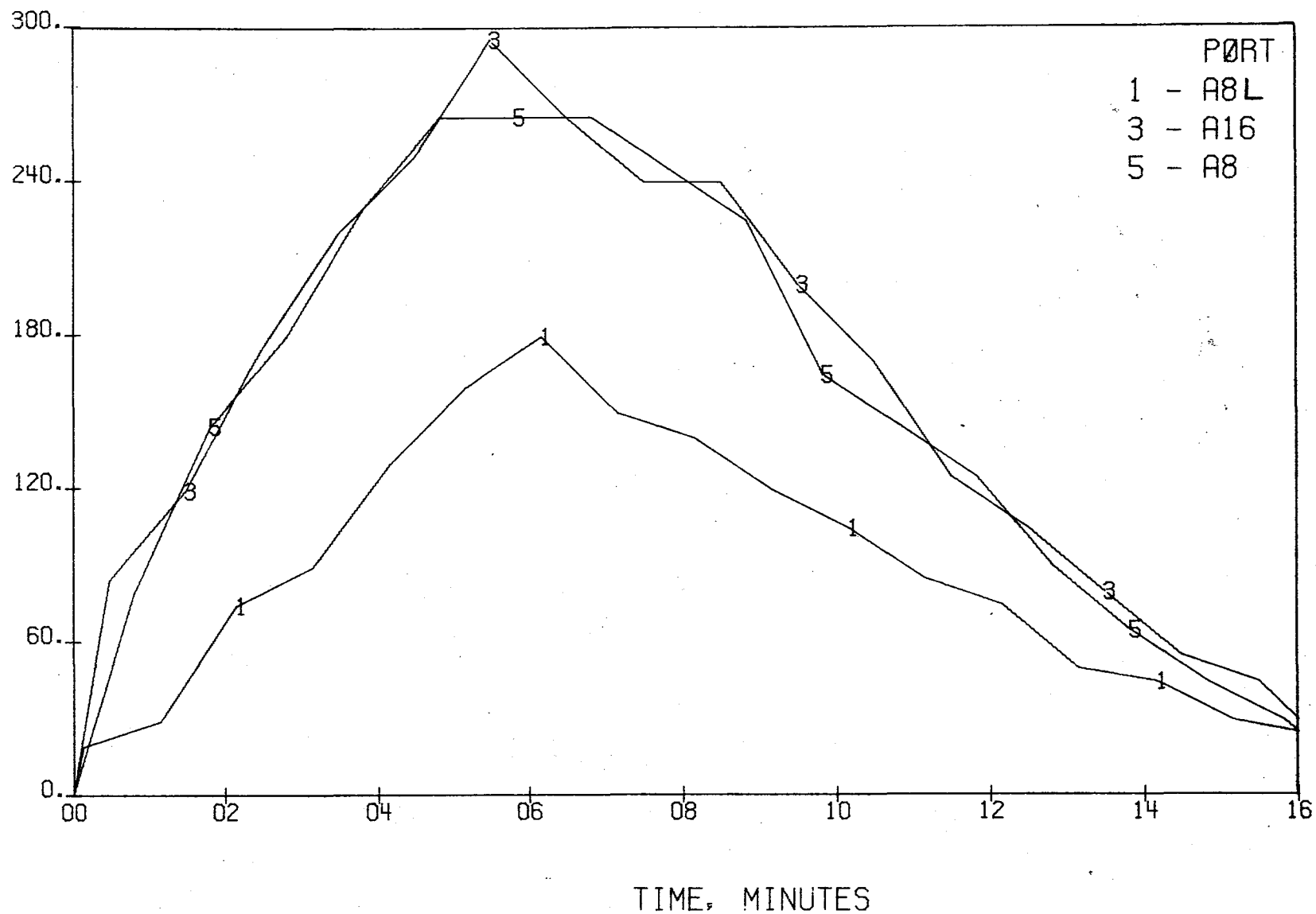


FIGURE 378 .- CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 18

493

CARBON MONOXIDE, PPM

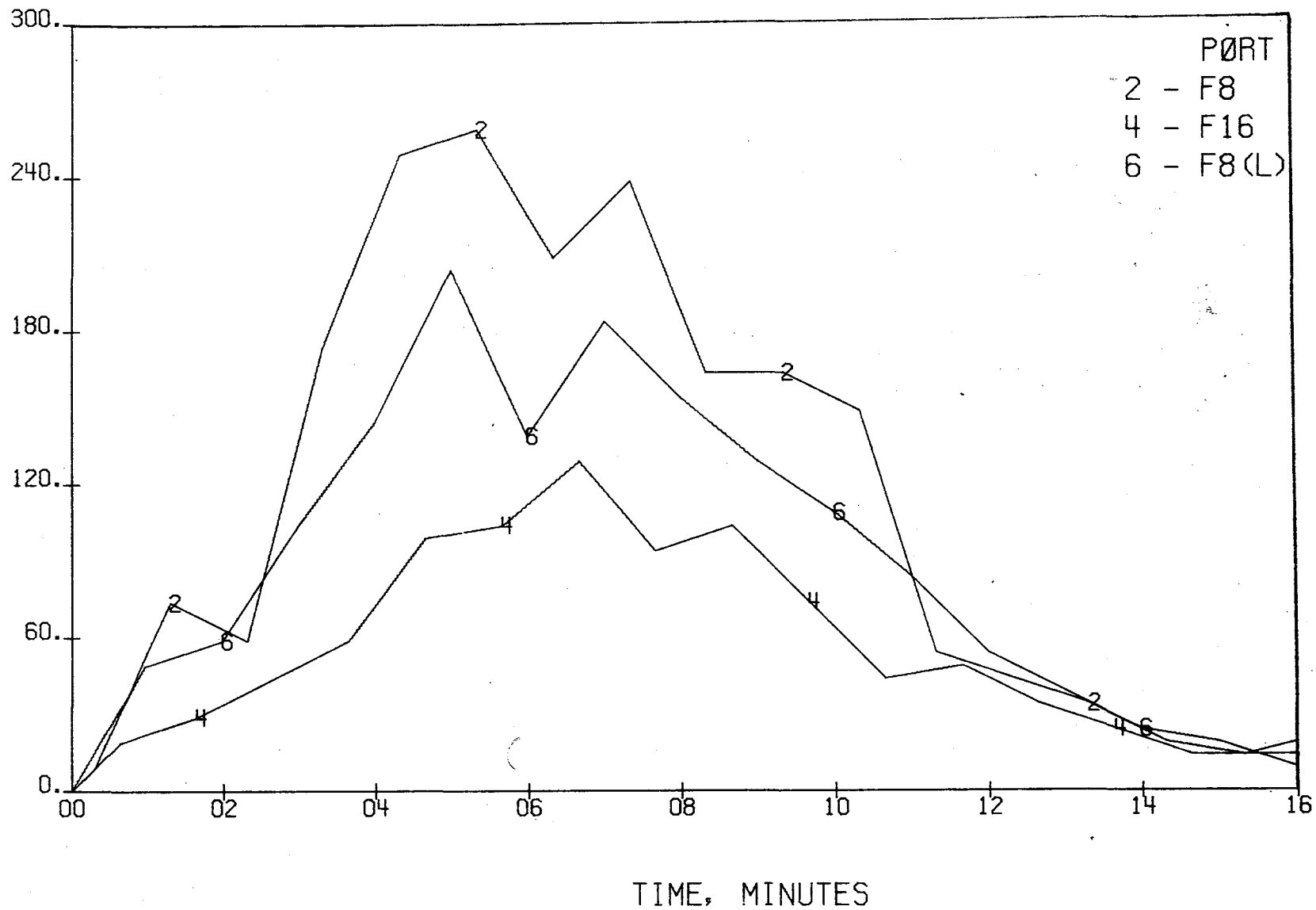


FIGURE 379 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 18

CARBON DIOXIDE, PERCENT

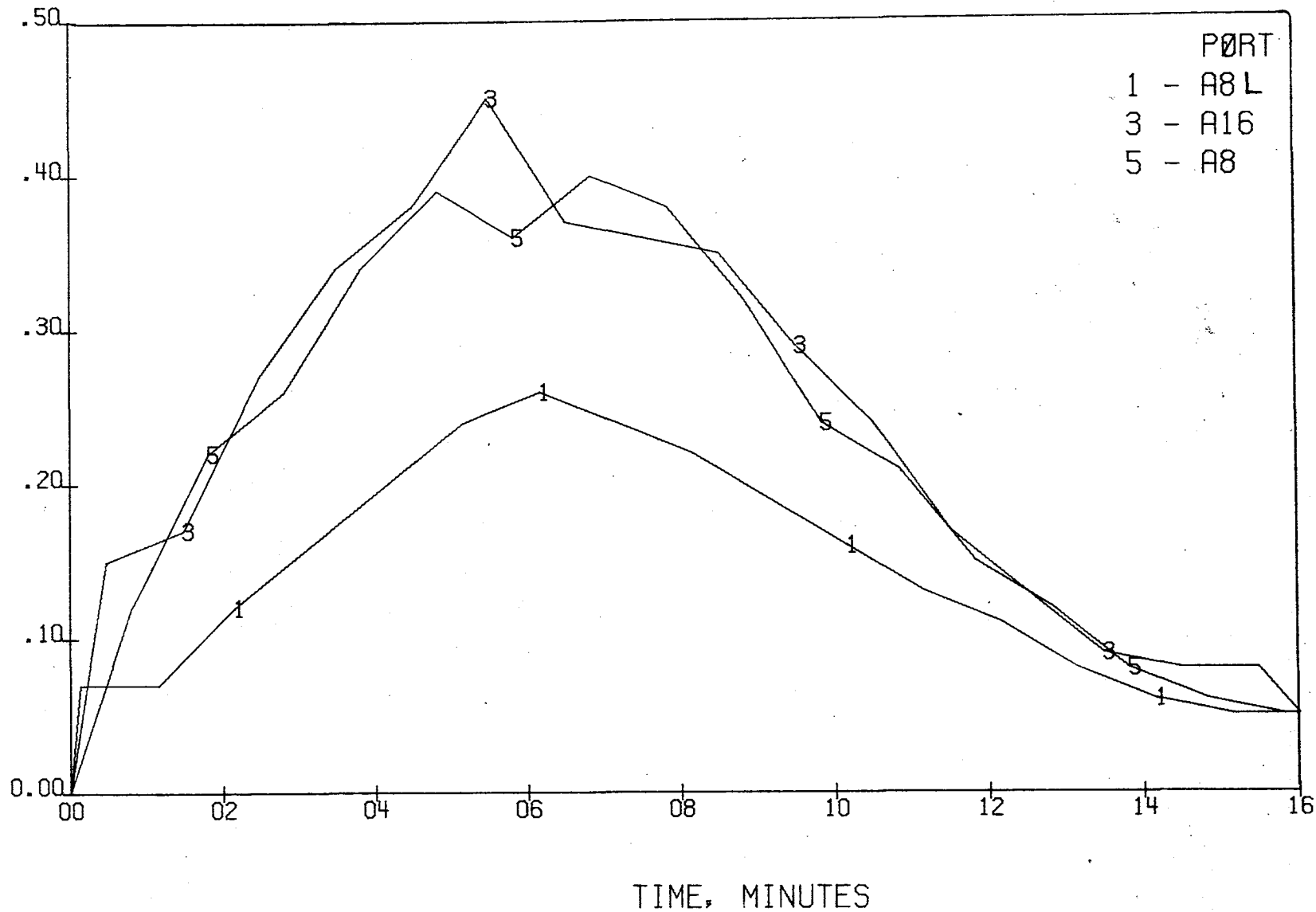


FIGURE 380.- CARBON DIOXIDE CONCENTRATIONS, AFT TEST 18

CARBON DIOXIDE, PERCENT

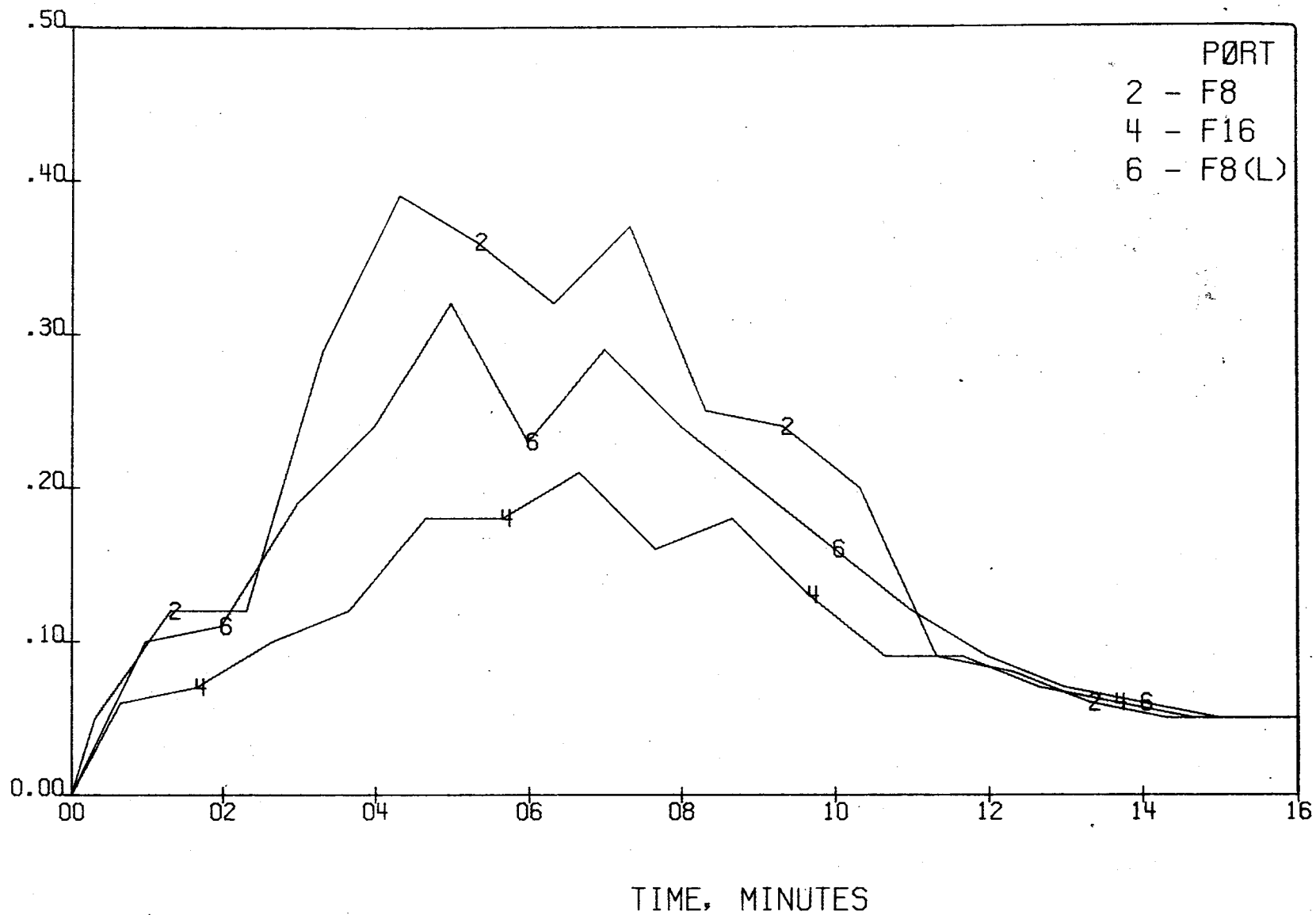


FIGURE 381 - CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 18

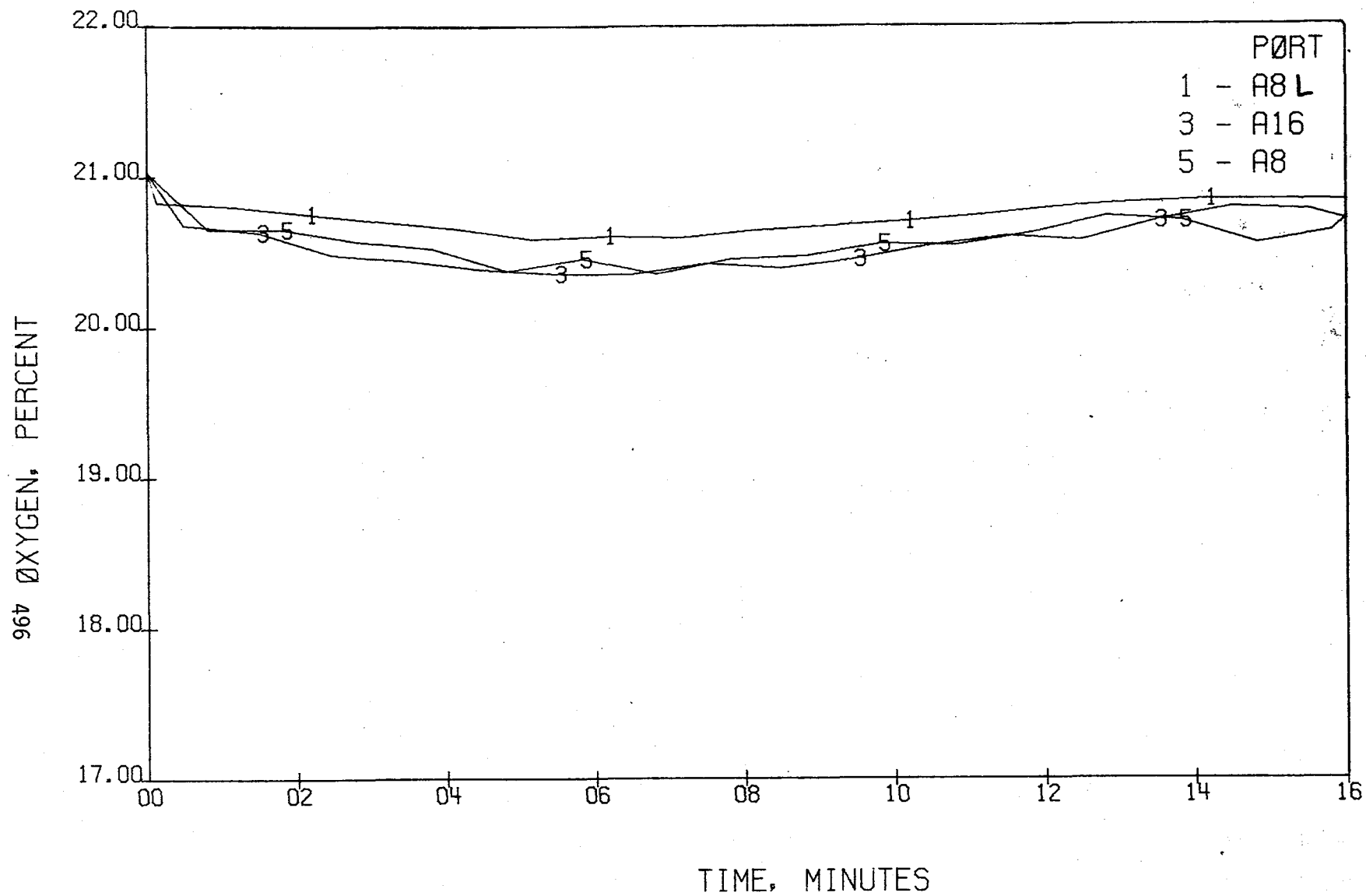


FIGURE 382 . - ØXYGEN CØNCENTRATIONS , AFT  
TEST 18



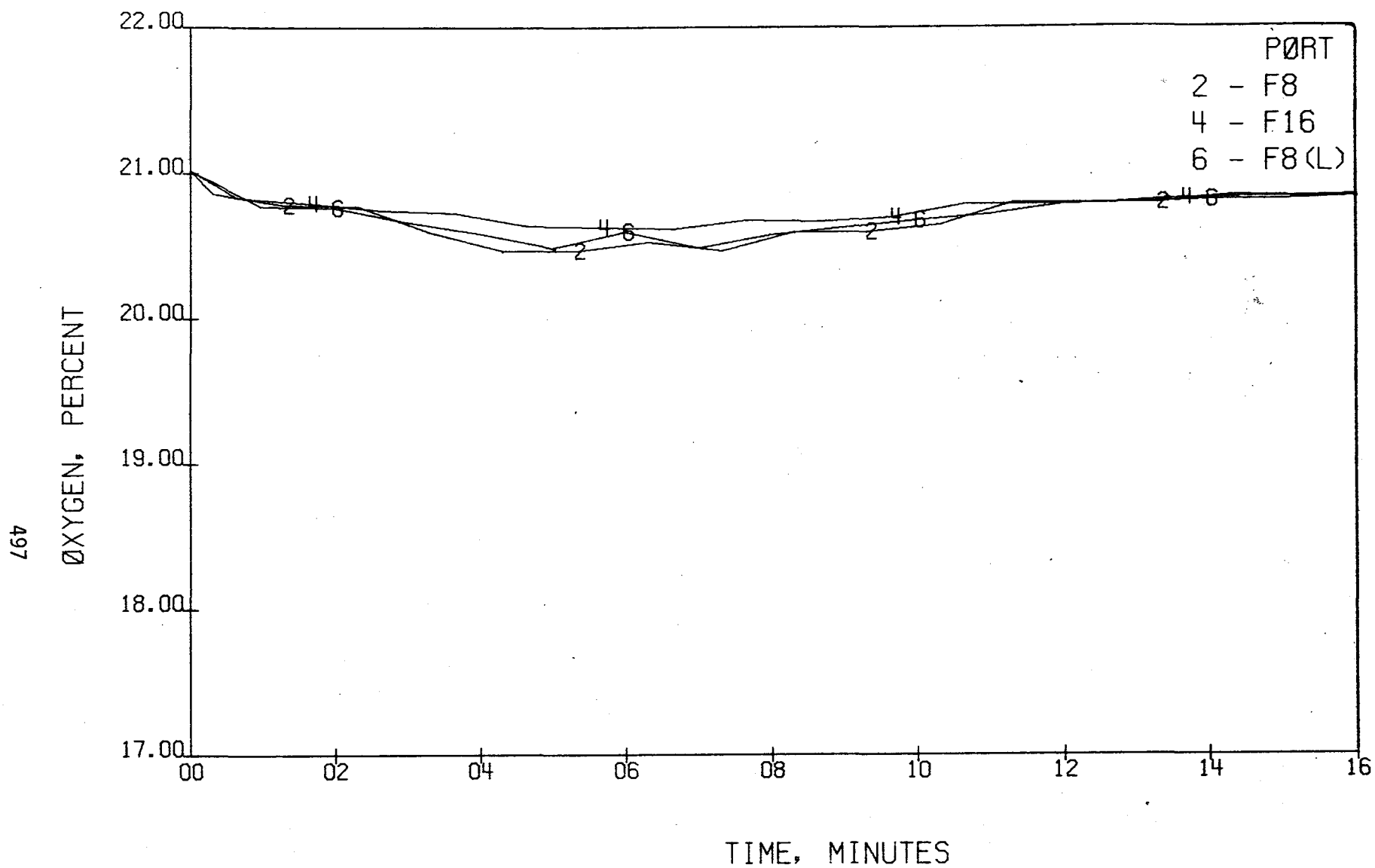


FIGURE 383. - OXYGEN CONCENTRATIONS, FØRE TEST 18

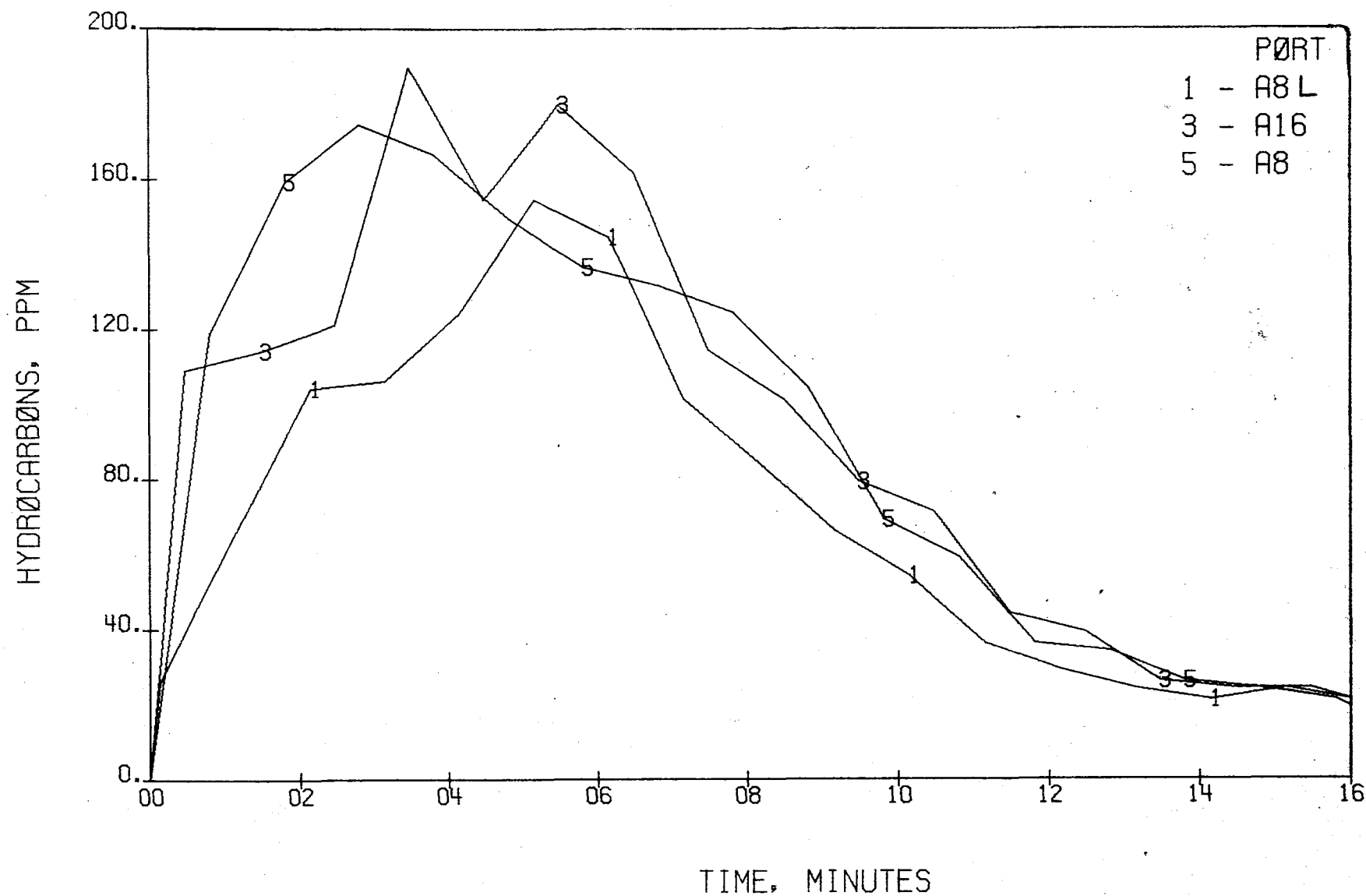


FIGURE 384 . - HYDROCARBONS CONCENTRATIONS , AFT  
TEST 18

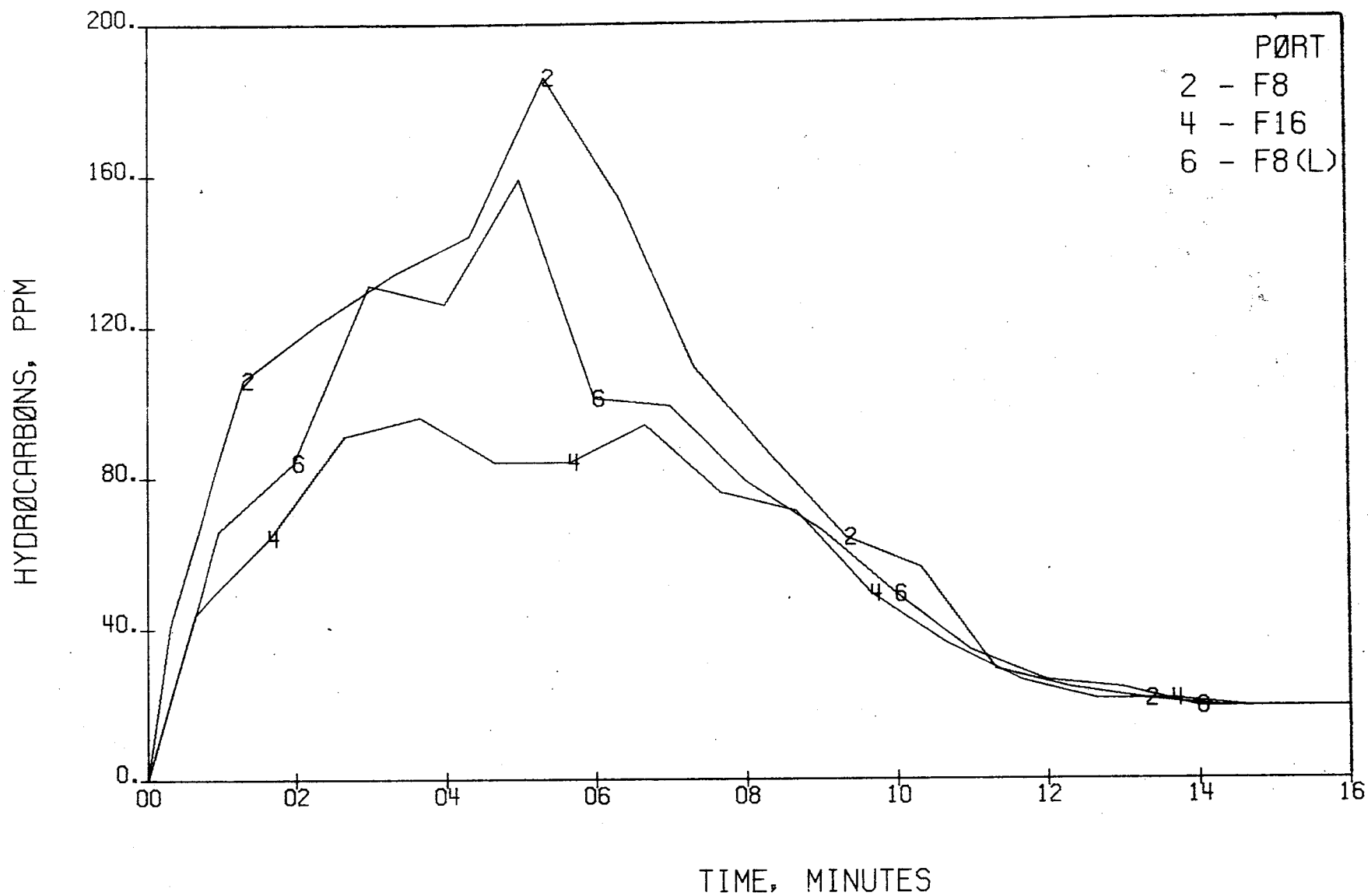


FIGURE 385 - HYDROCARBONS CONCENTRATIONS, FØRE TEST 18



TEST 19

---

WALL PANEL

TEST 19

---

WALL PANEL

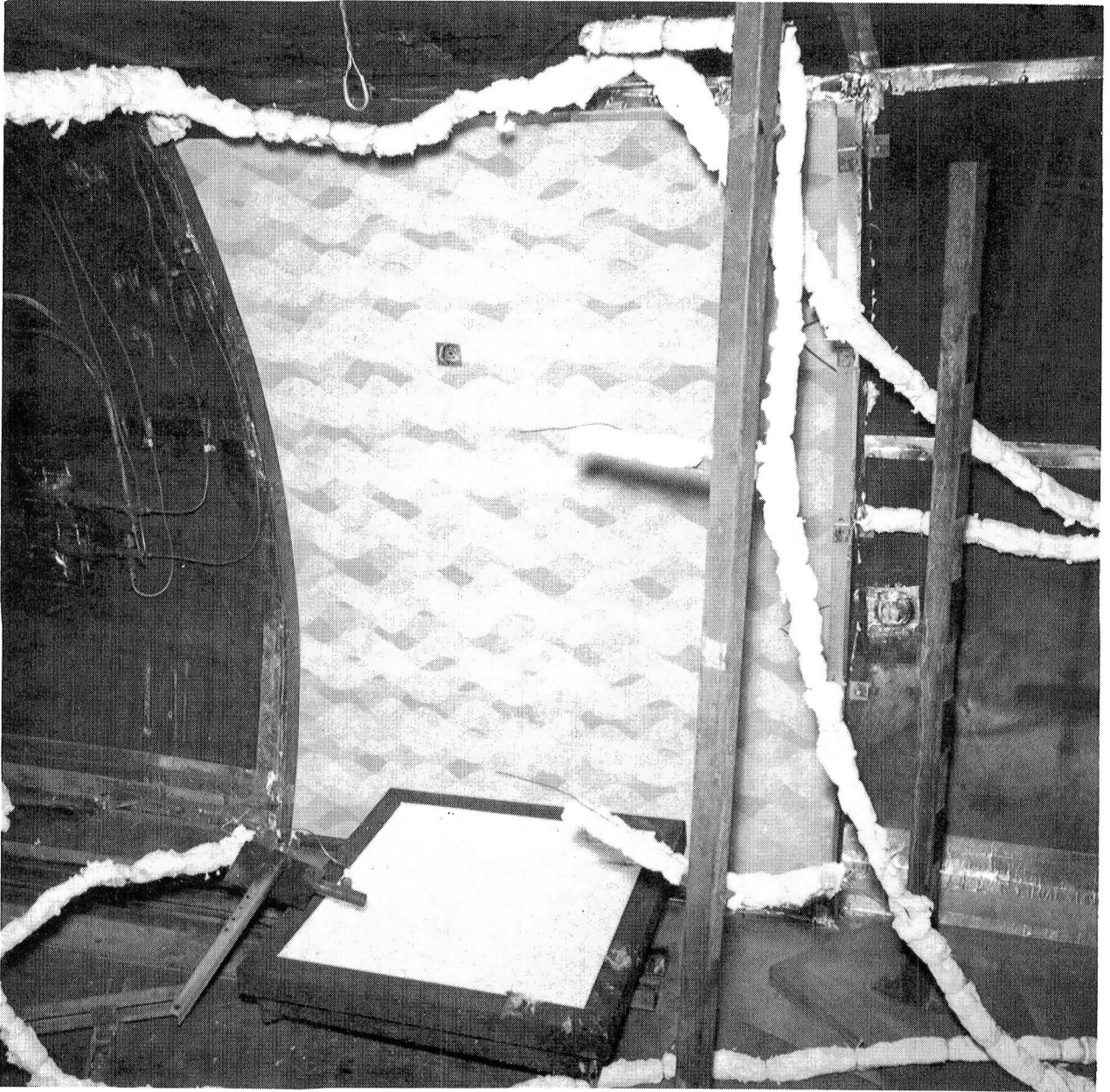


FIGURE 386. - PRE-TEST CONFIGURATION, TEST 19



FIGURE 387, - POST-TEST CONFIGURATION, TEST 19



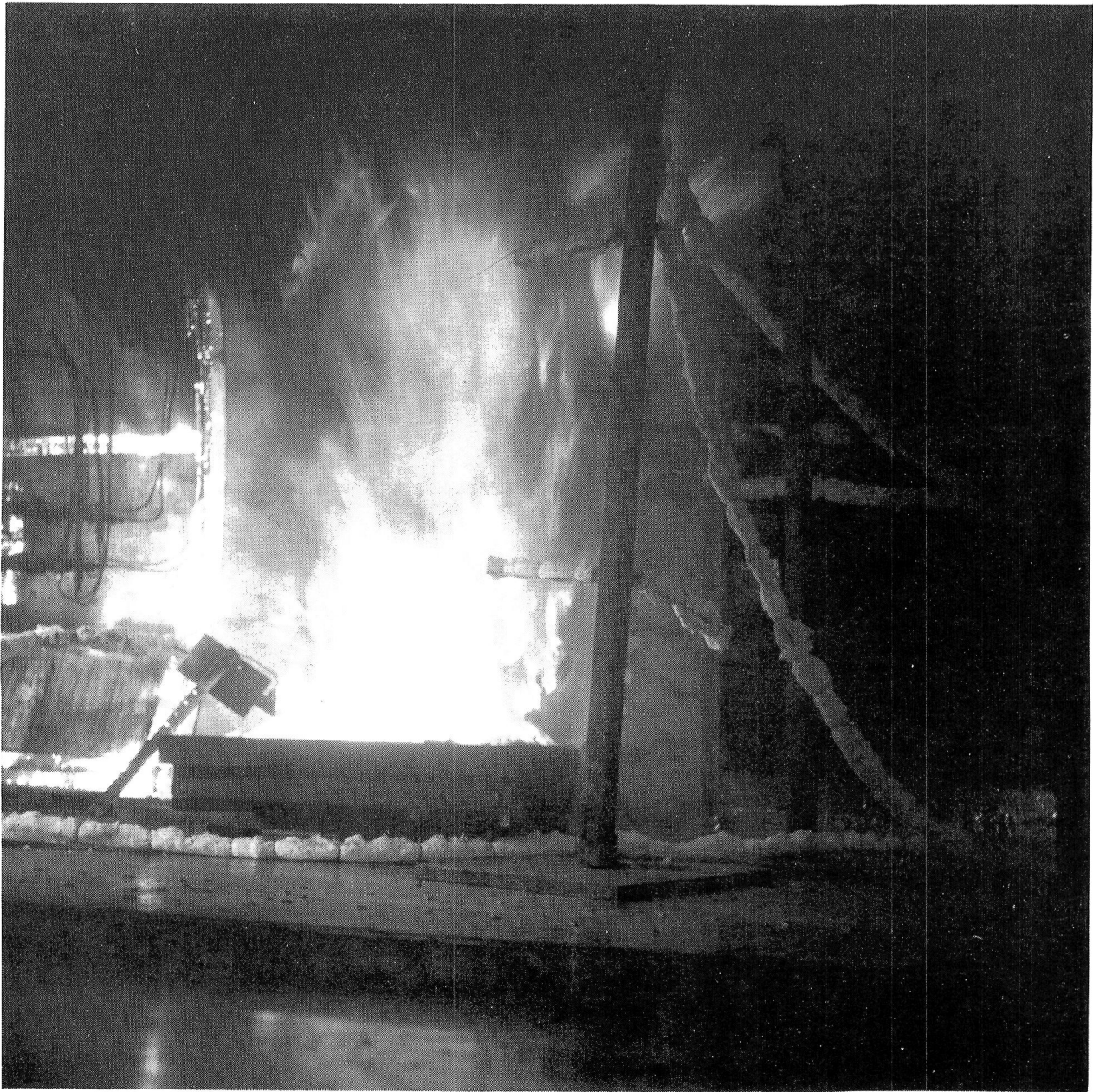


FIGURE 388 . - FIRE DURING TEST 19



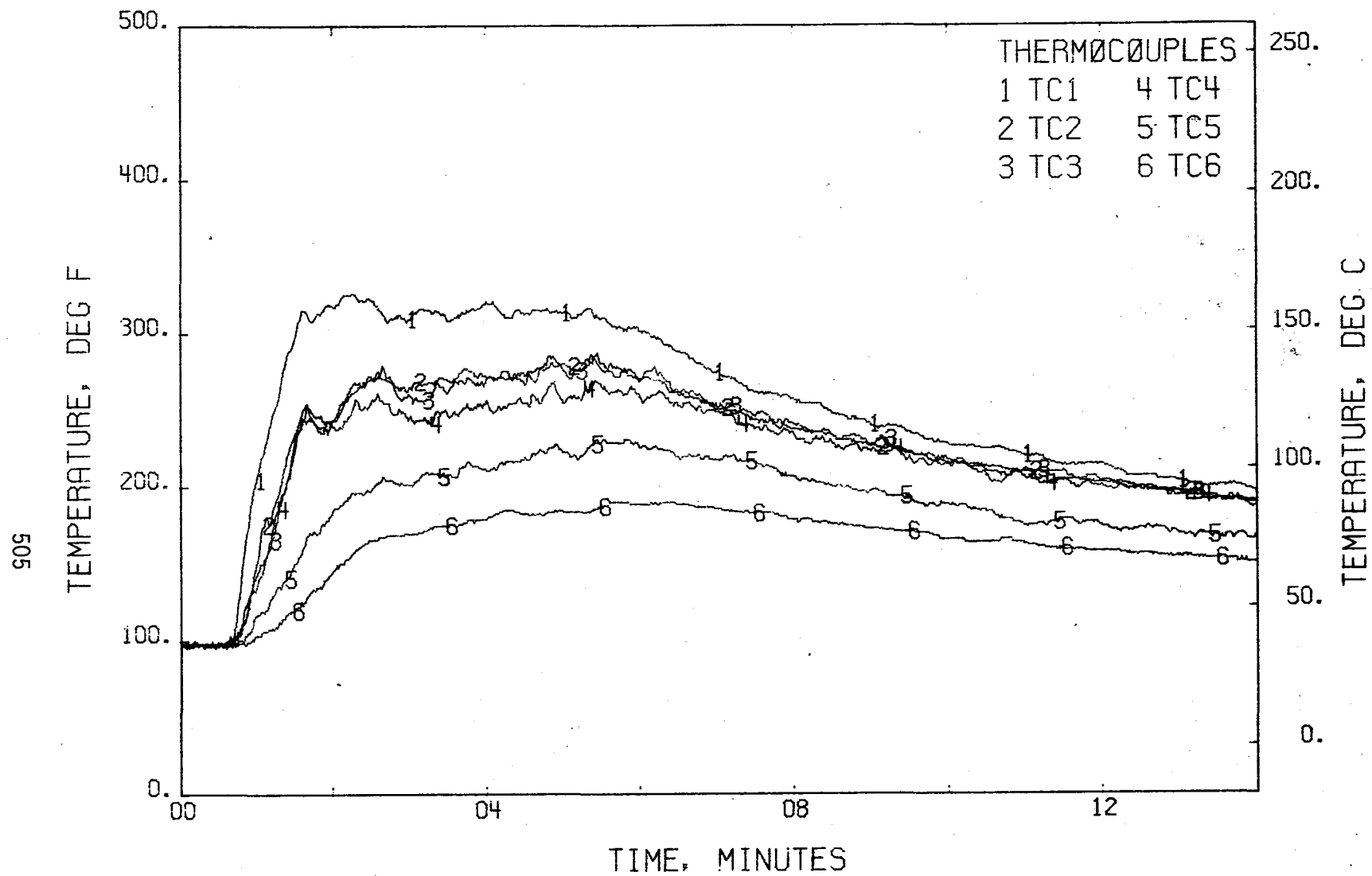


FIGURE 389 . - TEMPERATURES, T/C TREE 1  
TEST 19

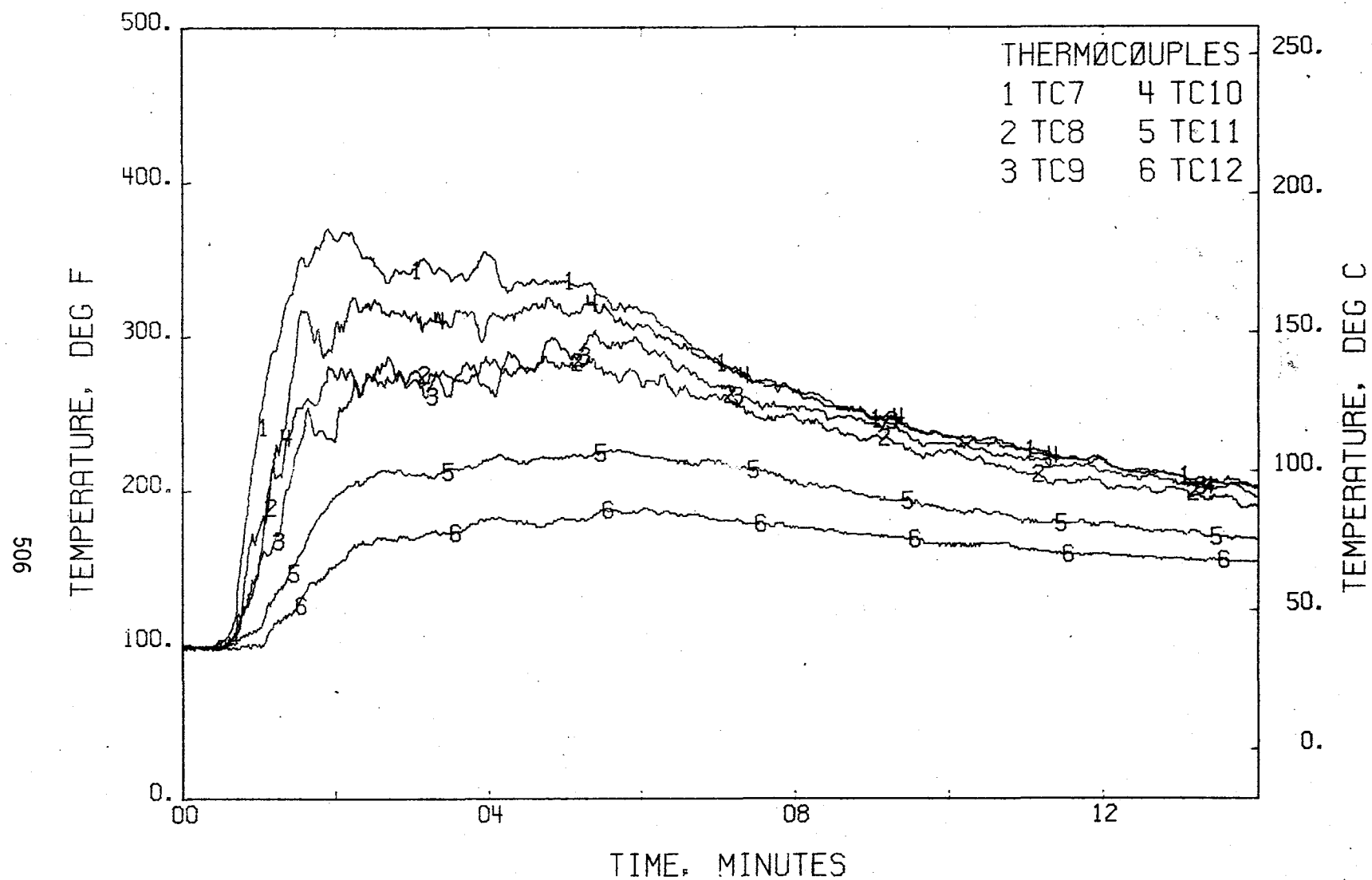


FIGURE 390 . - TEMPERATURES, T/C TREE 2  
TEST 19

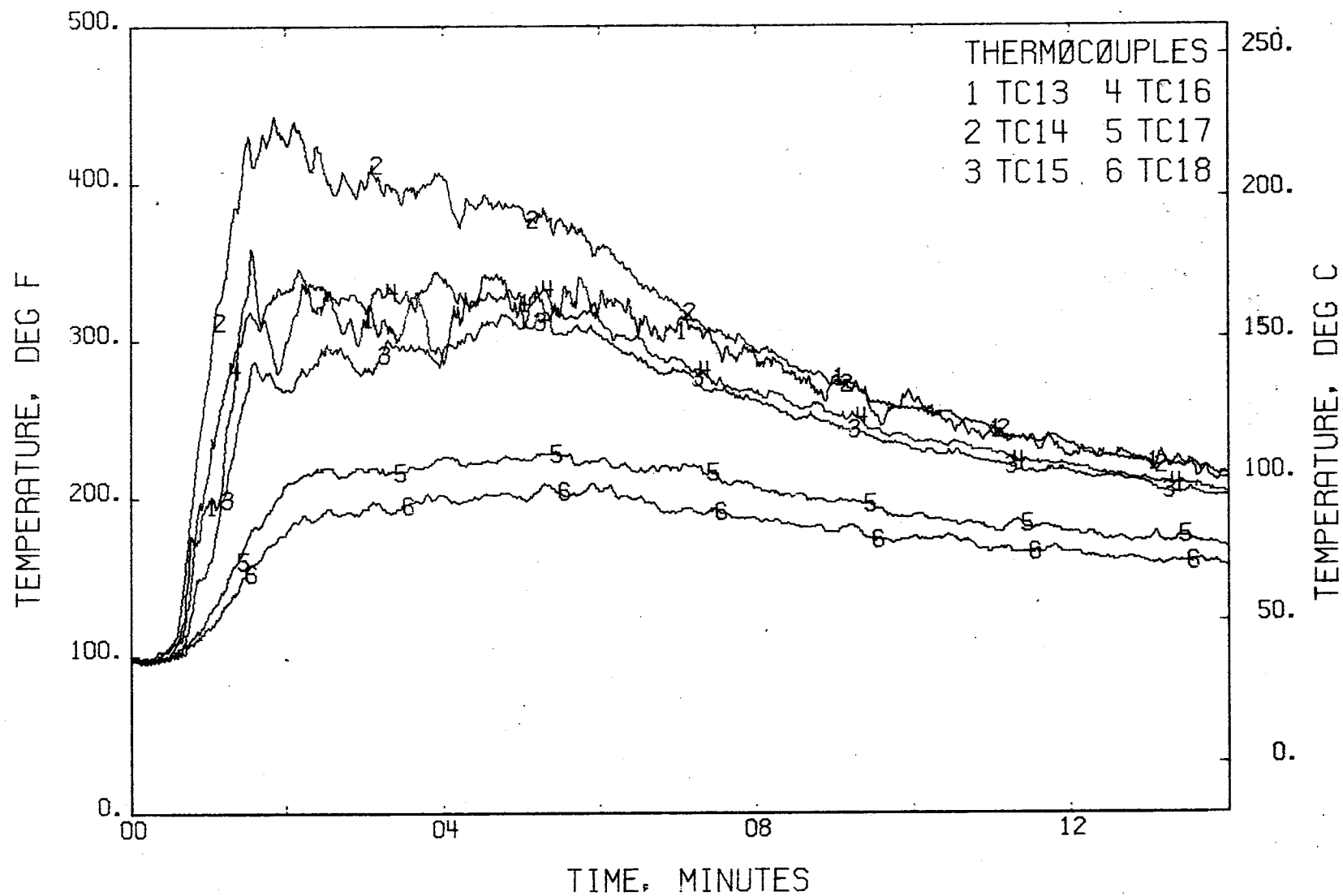


FIGURE 391 . - TEMPERATURES, T/C TREE 3  
TEST 19

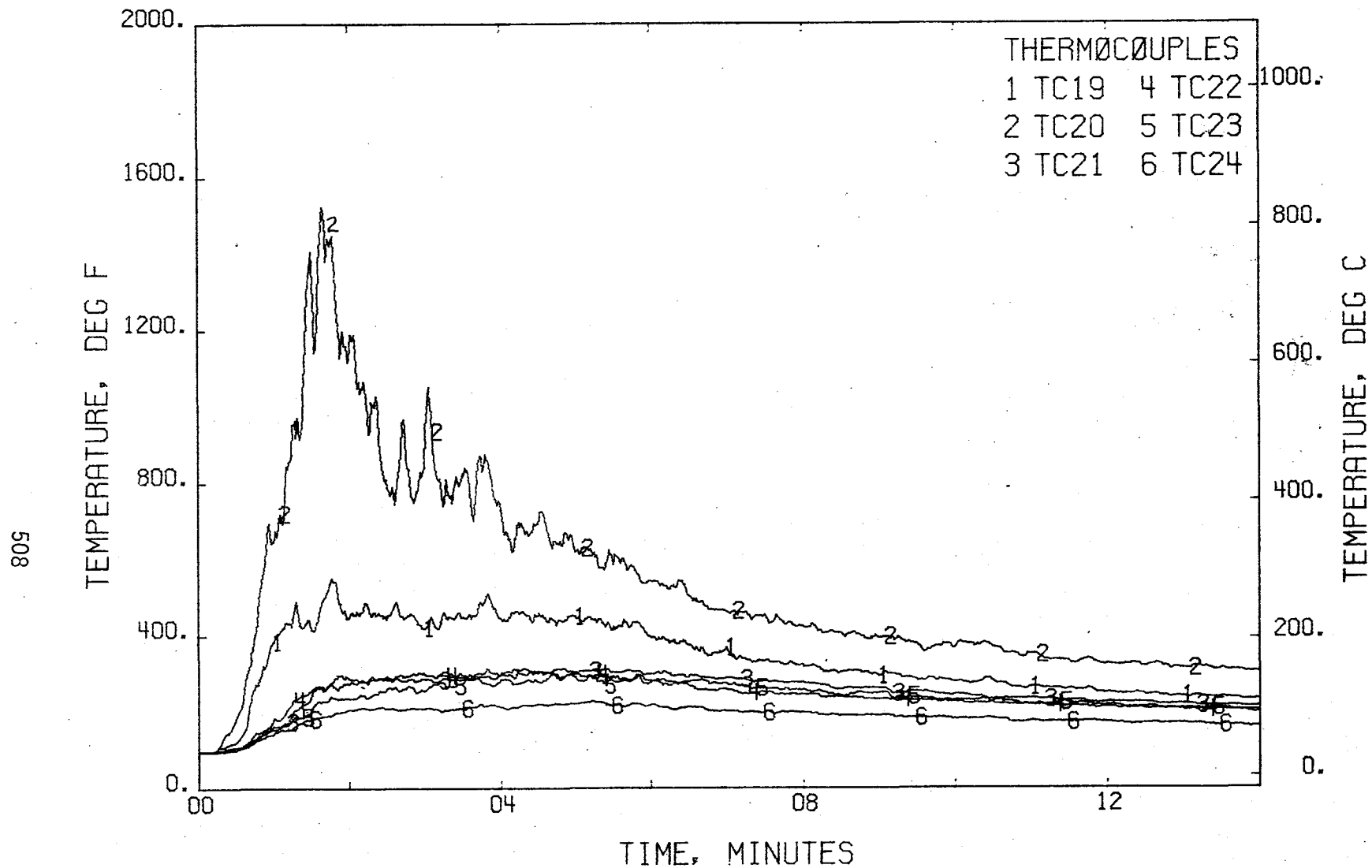


FIGURE 392 . - TEMPERATURES, T/C TREE 4  
TEST 19

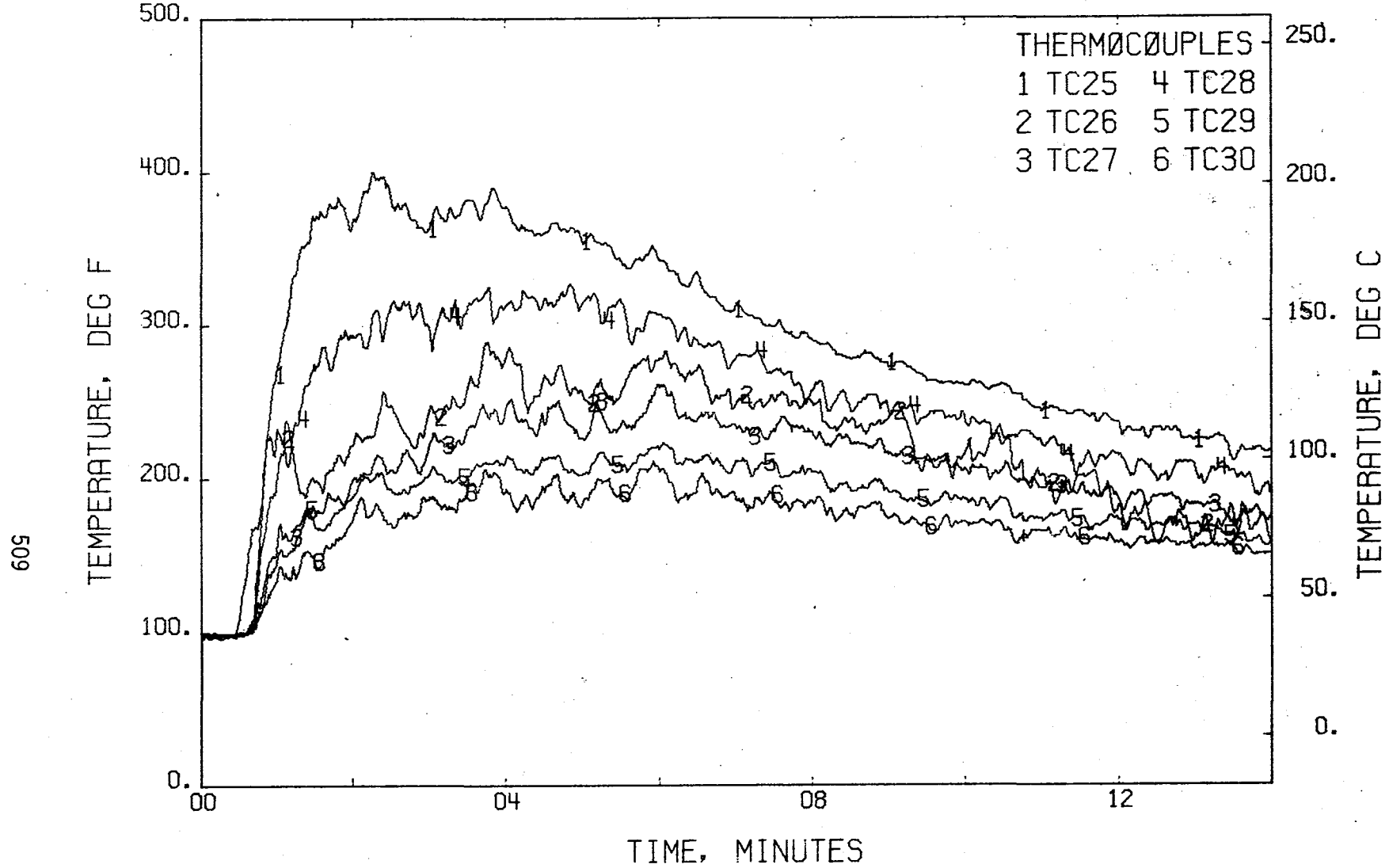


FIGURE 393 . - TEMPERATURES, T/C TREE 5  
TEST 19

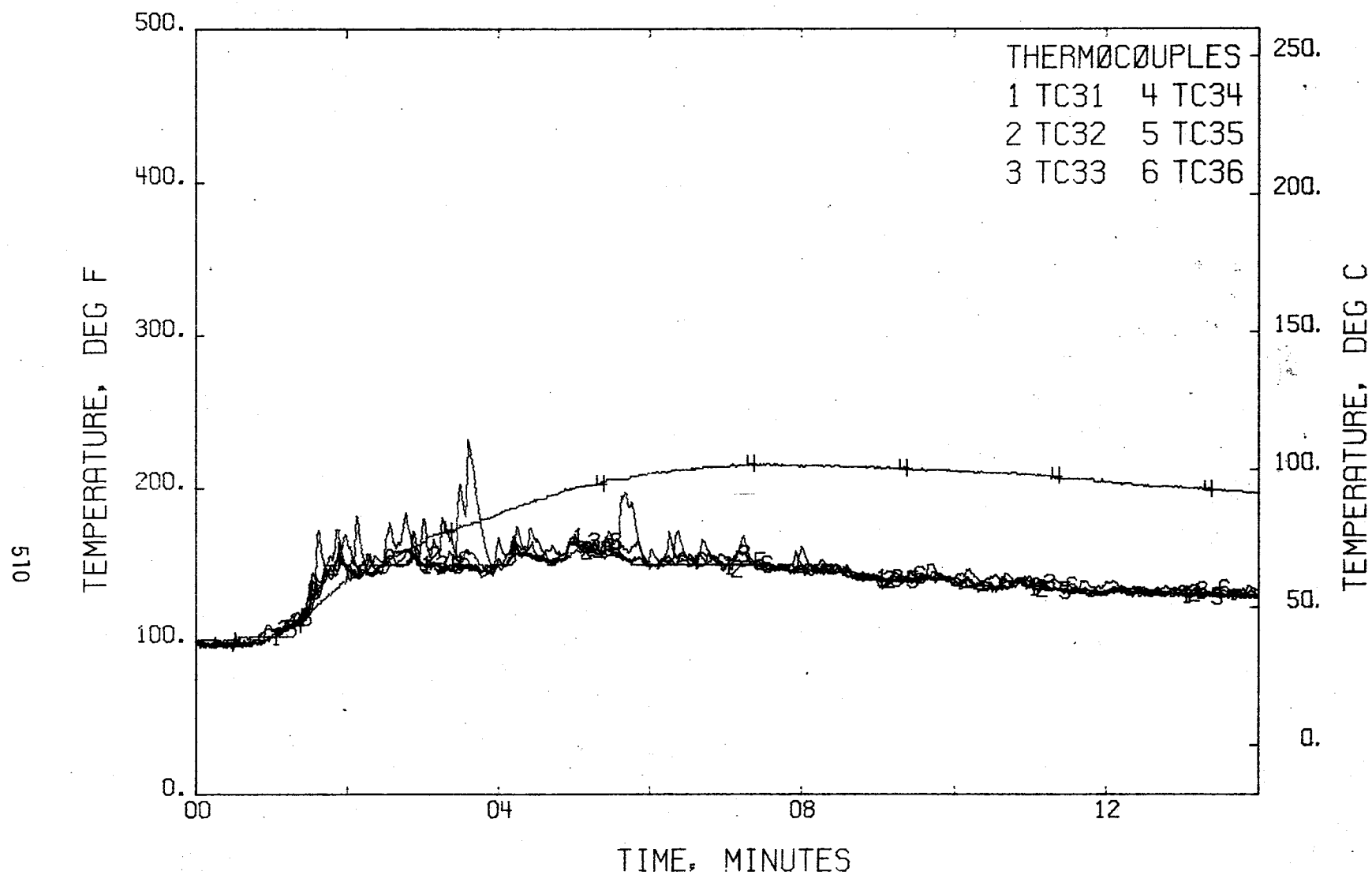


FIGURE 394 . - TEMPERATURES, T/C TREE 6  
TEST 19

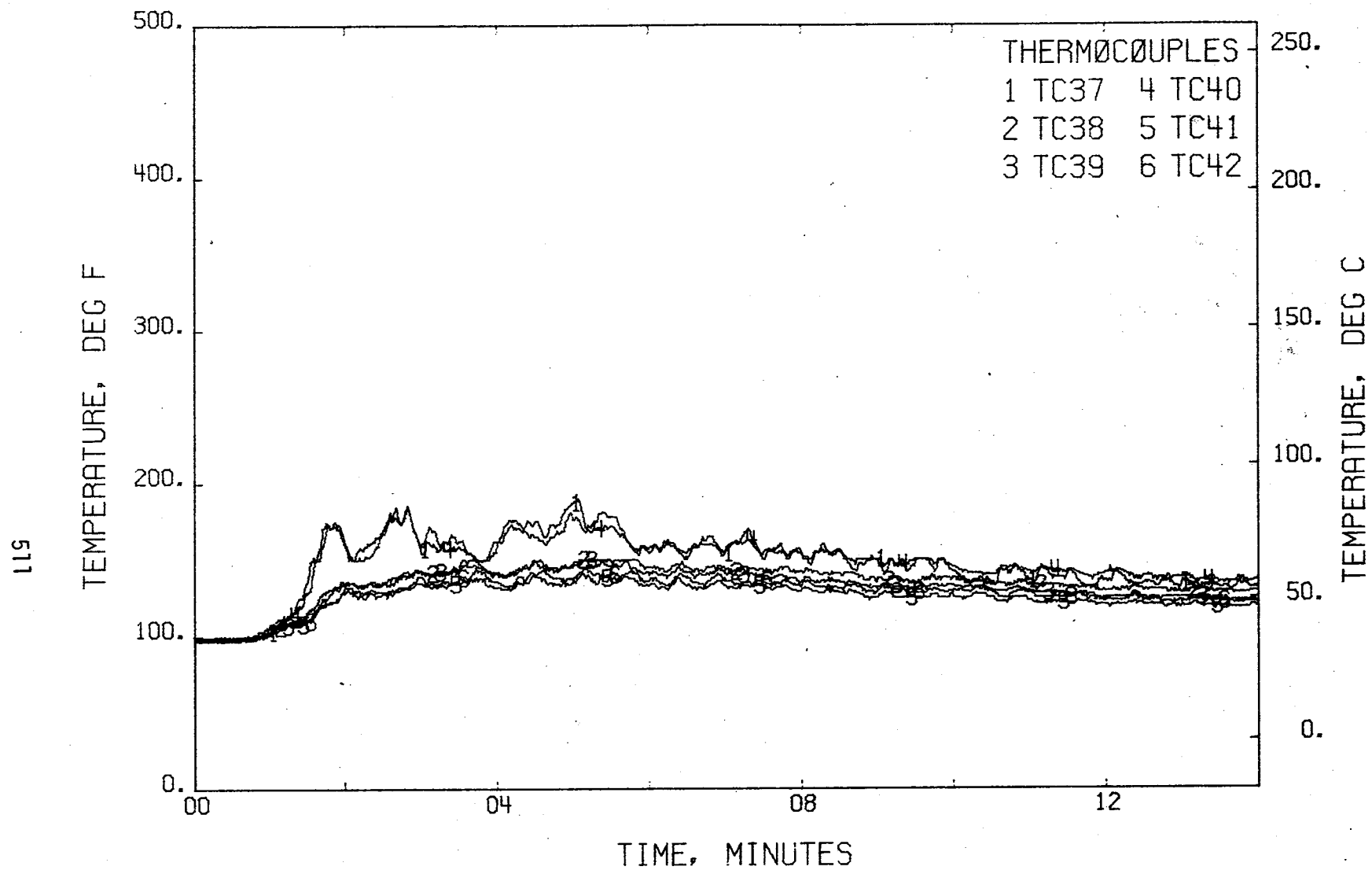


FIGURE 395 . - TEMPERATURES, T/C TREE 7  
TEST 19

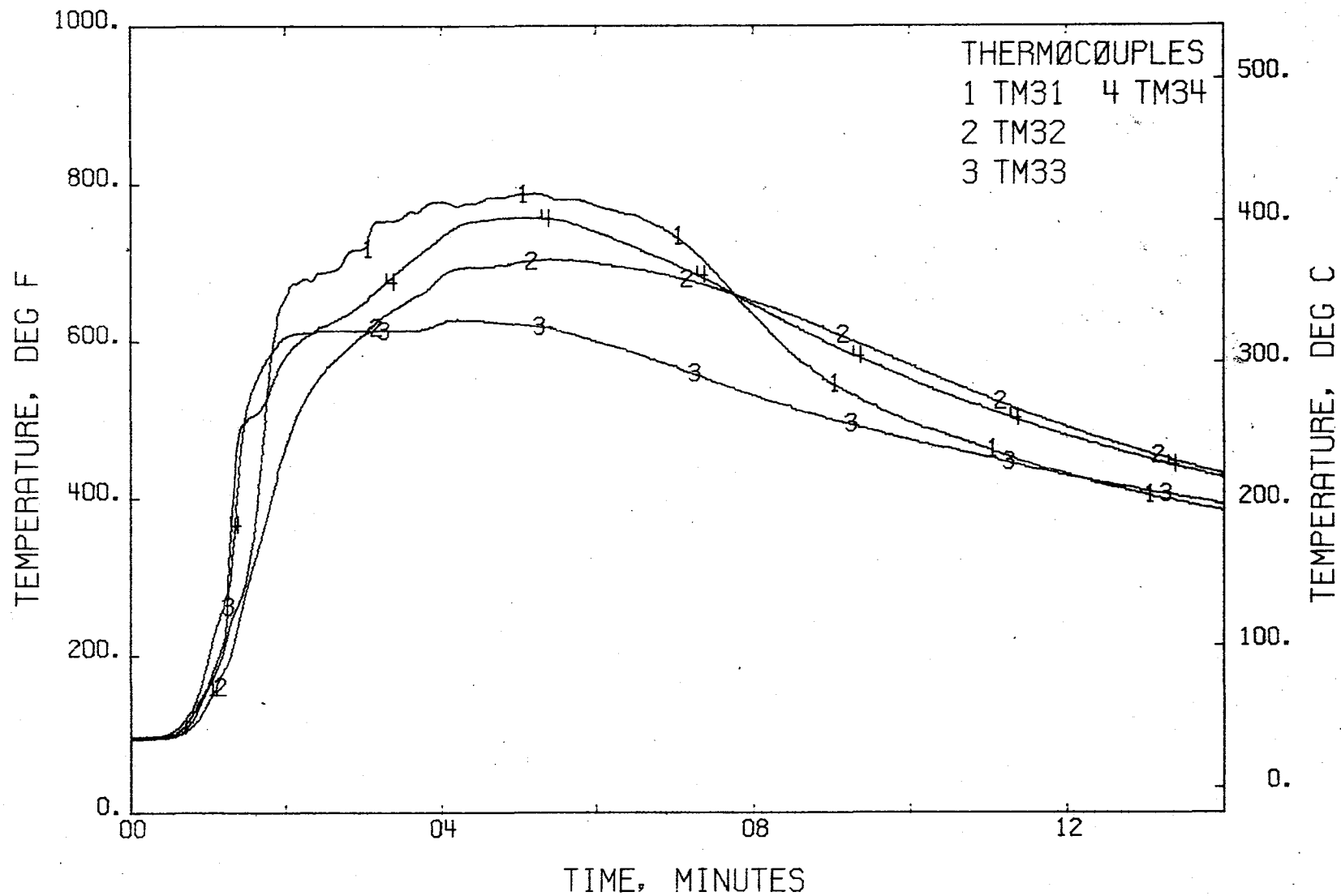


FIGURE 396 . - TEMPERATURES, SIDEWALL PANEL (TOP)  
TEST 19



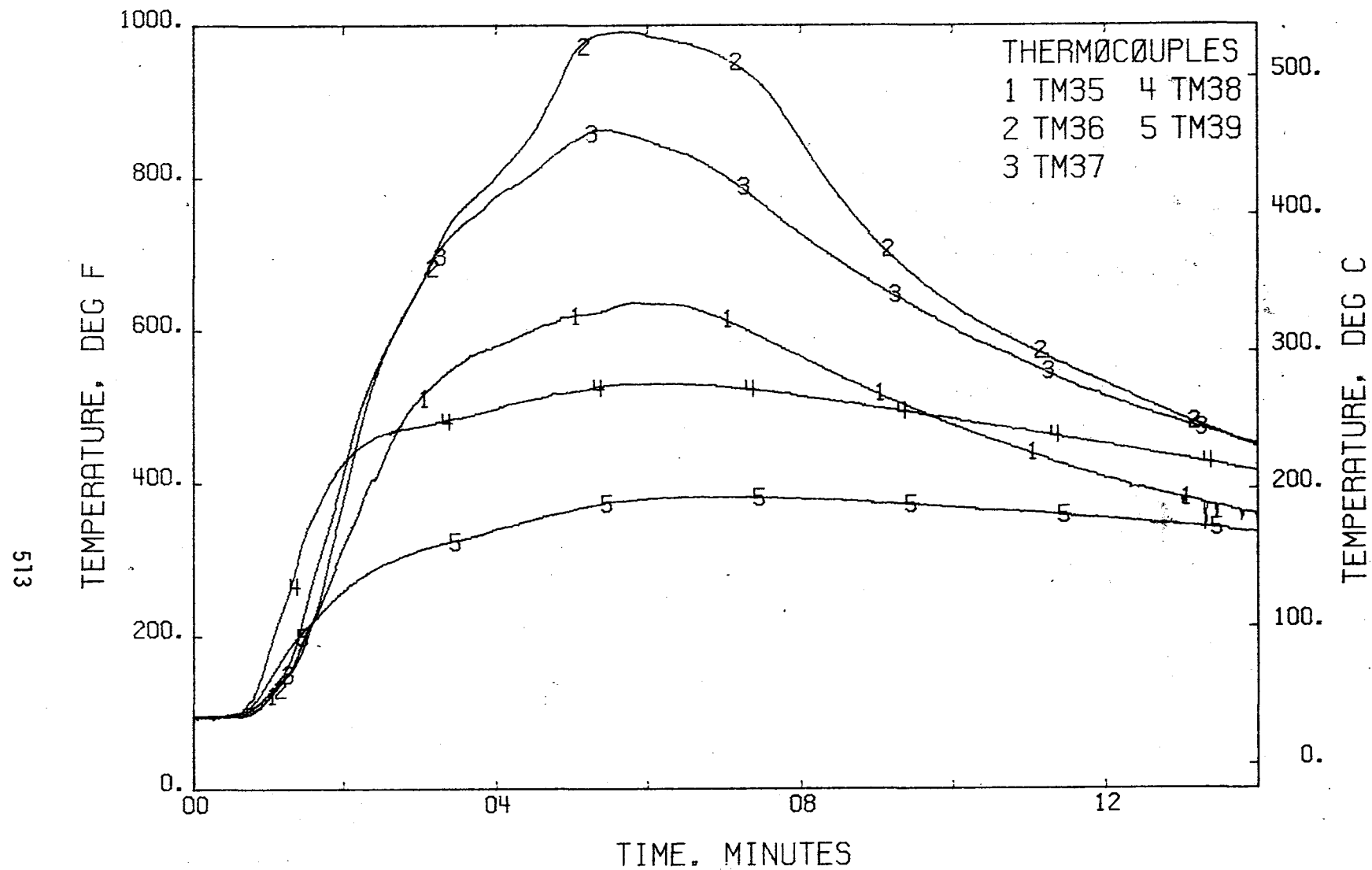


FIGURE 397 . - TEMPERATURES, SIDEWALL PANEL (CENTER)  
TEST 19

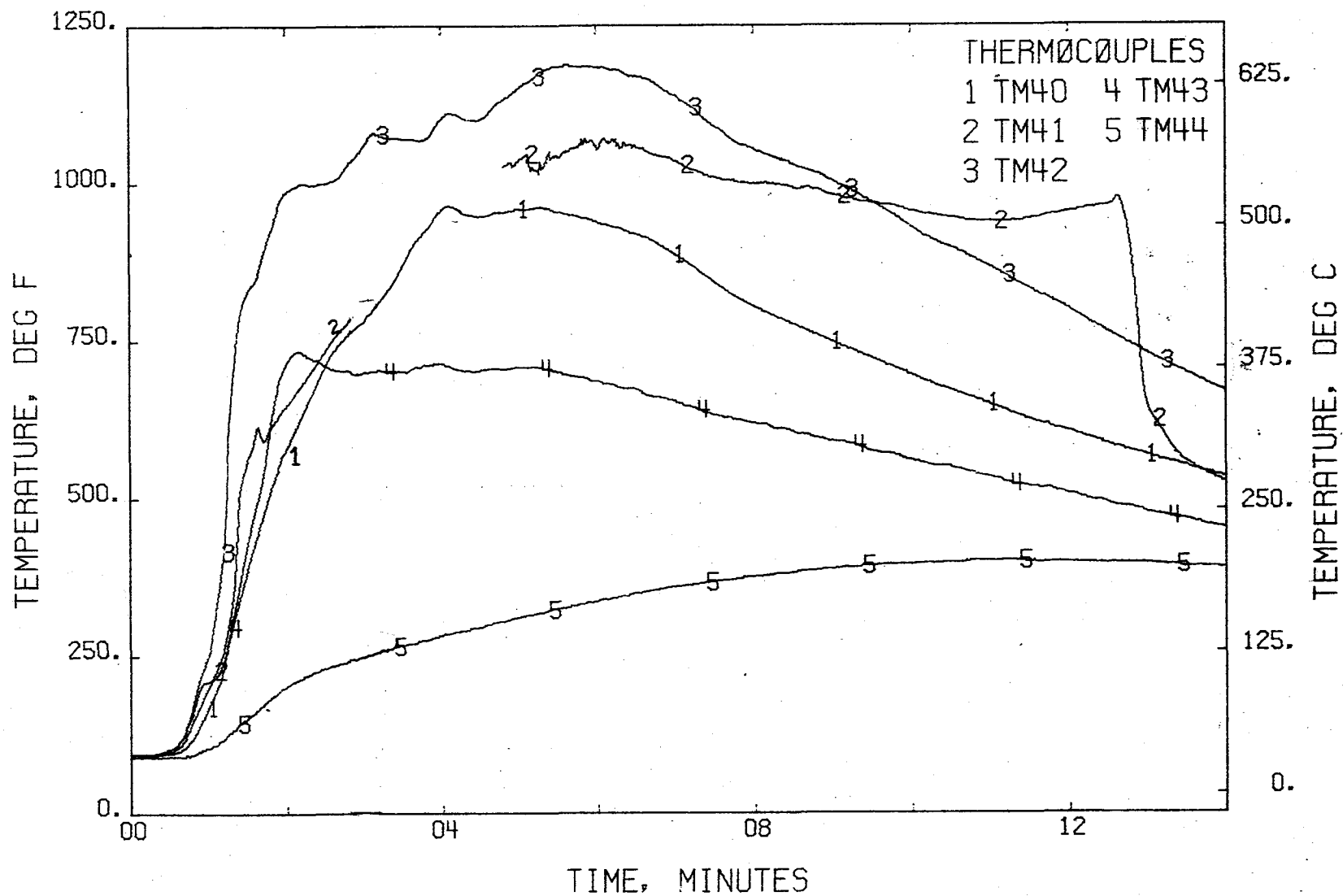


FIGURE 398 . - TEMPERATURES, SIDEWALL PANEL (BØTTØM)  
TEST 19

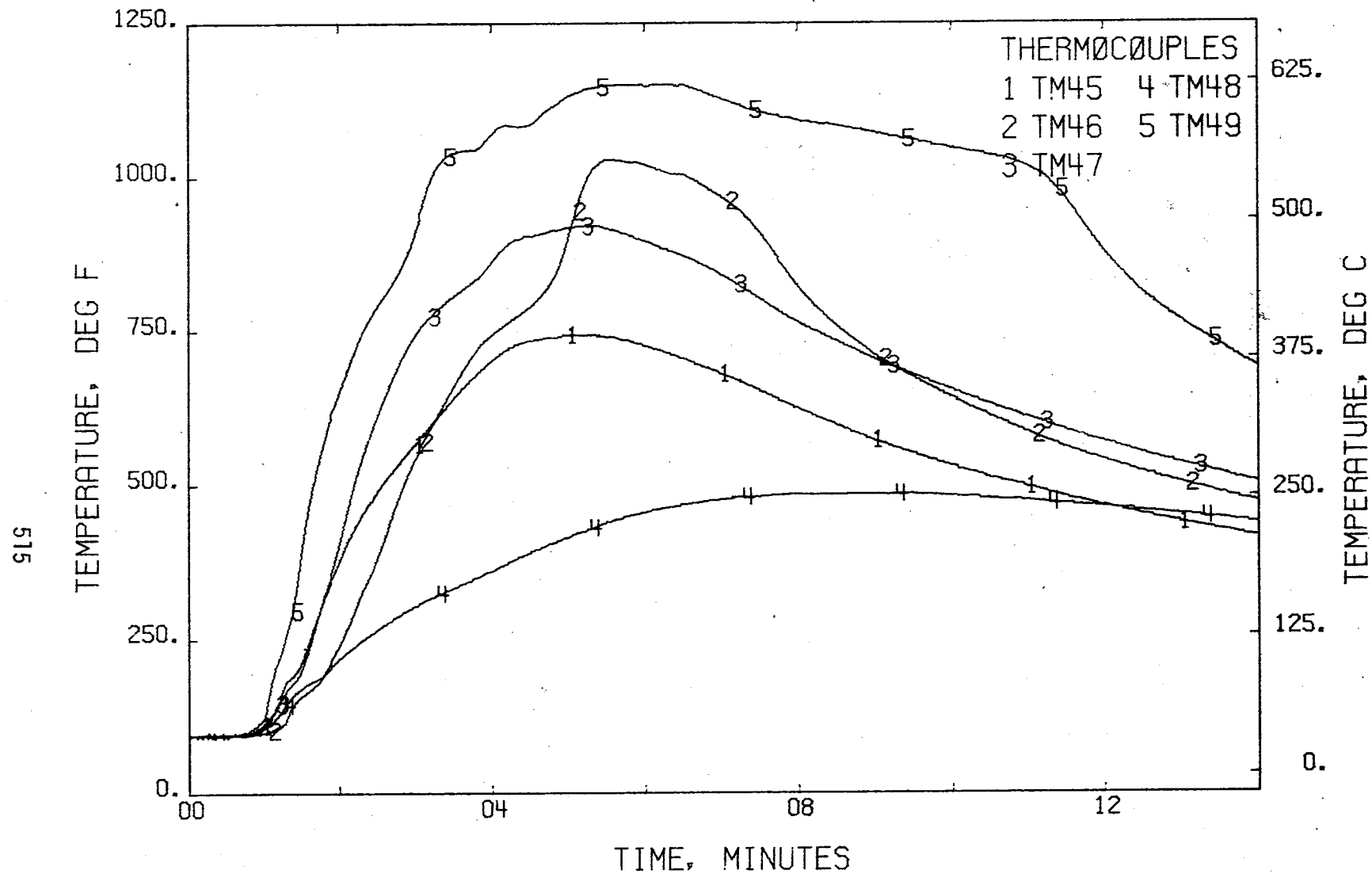


FIGURE 399 . - TEMPERATURES, SIDEWALL PANEL (REAR)  
TEST 19

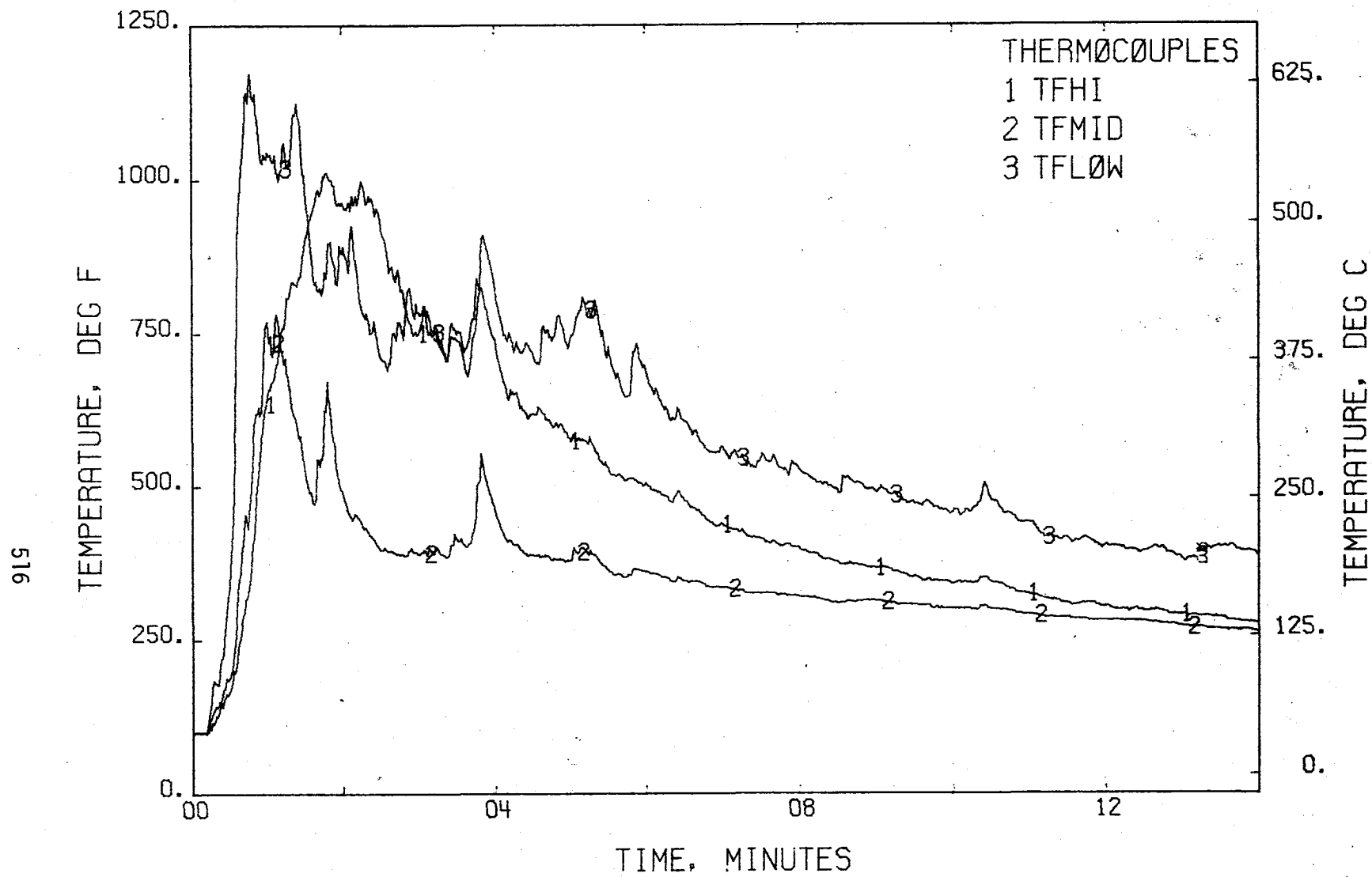


FIGURE 400 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 19

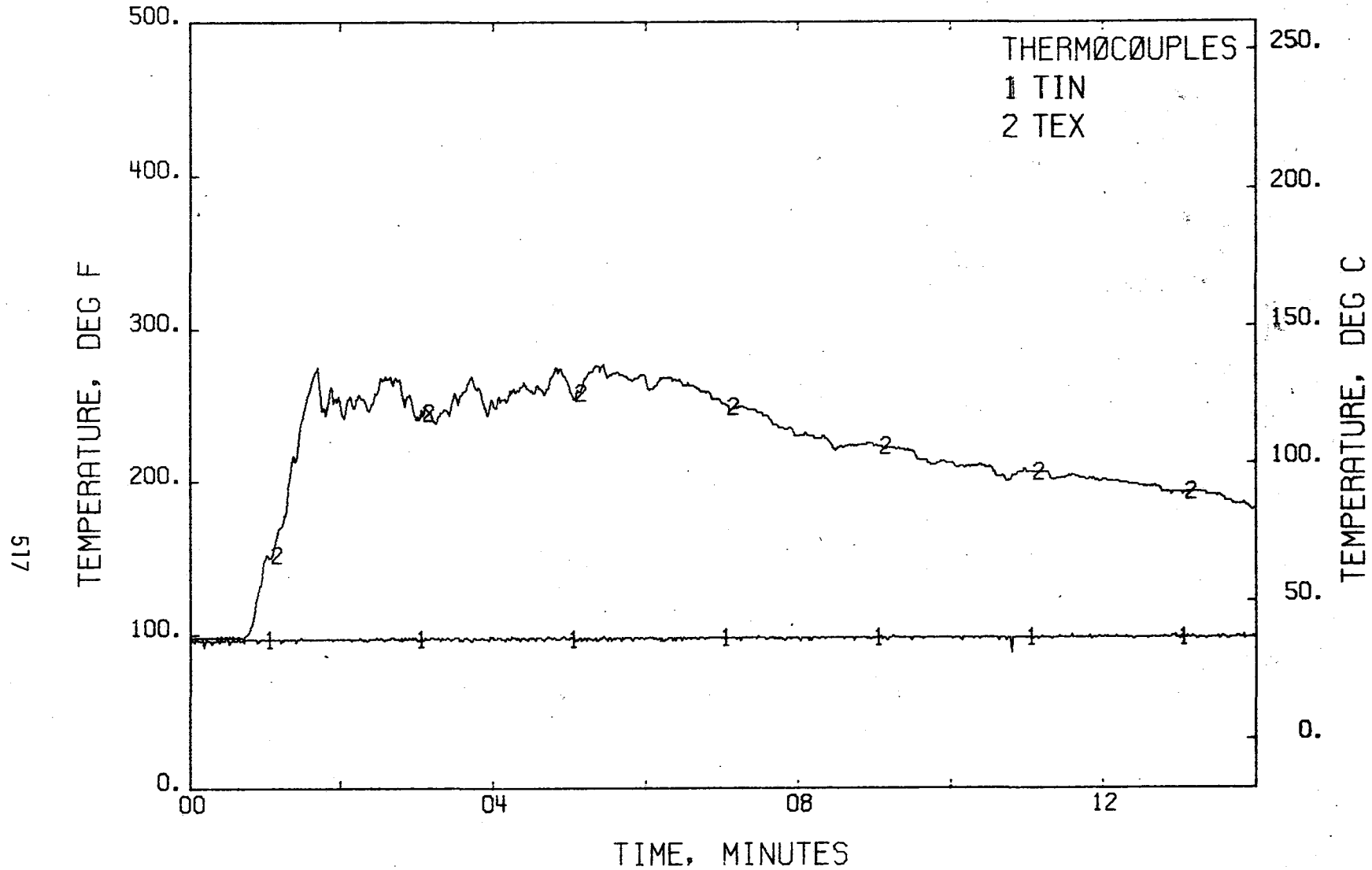


FIGURE 401 . - TEMPERATURES, INLET + EXIT  
TEST 19

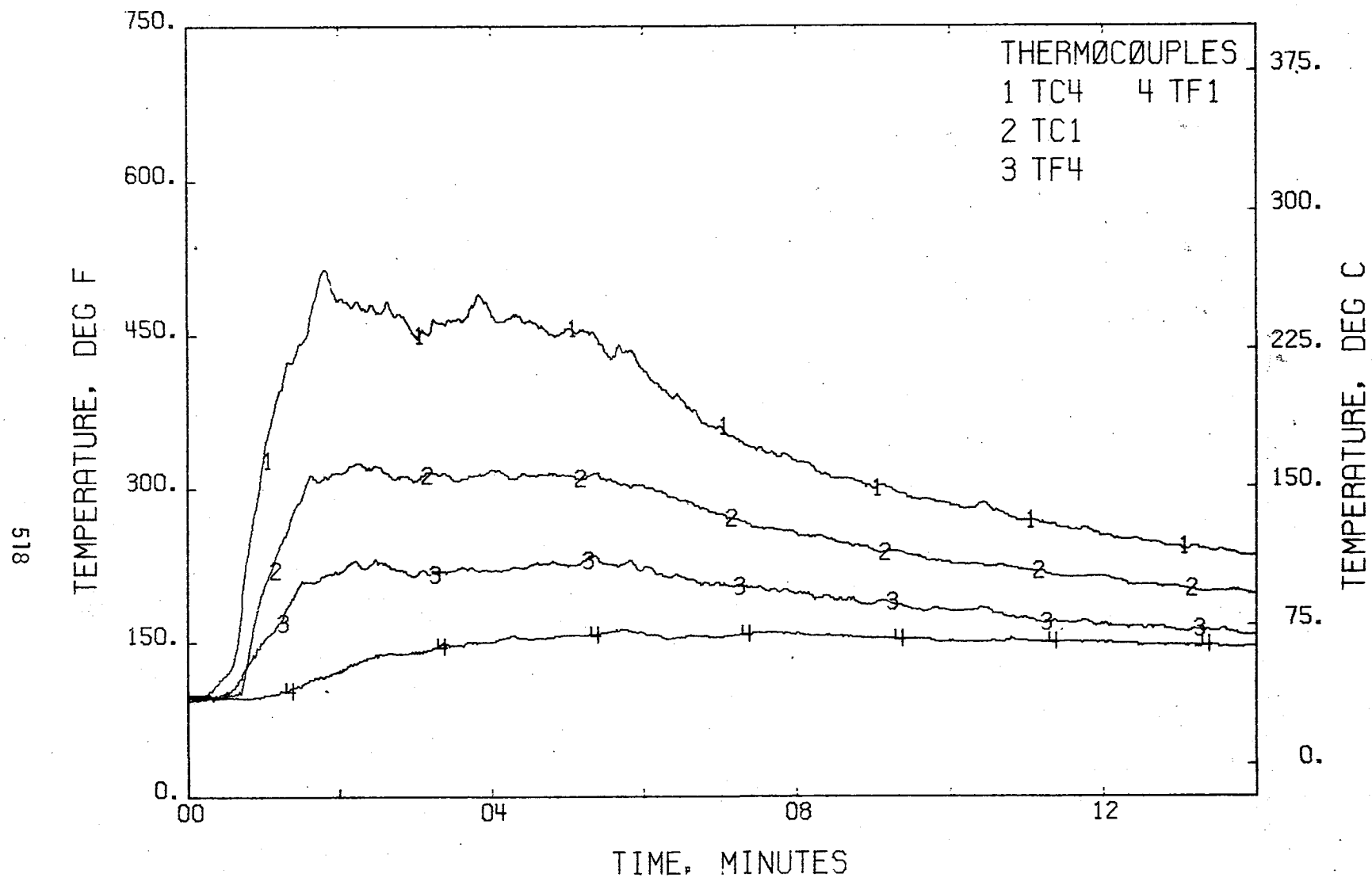


FIGURE 402 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 19

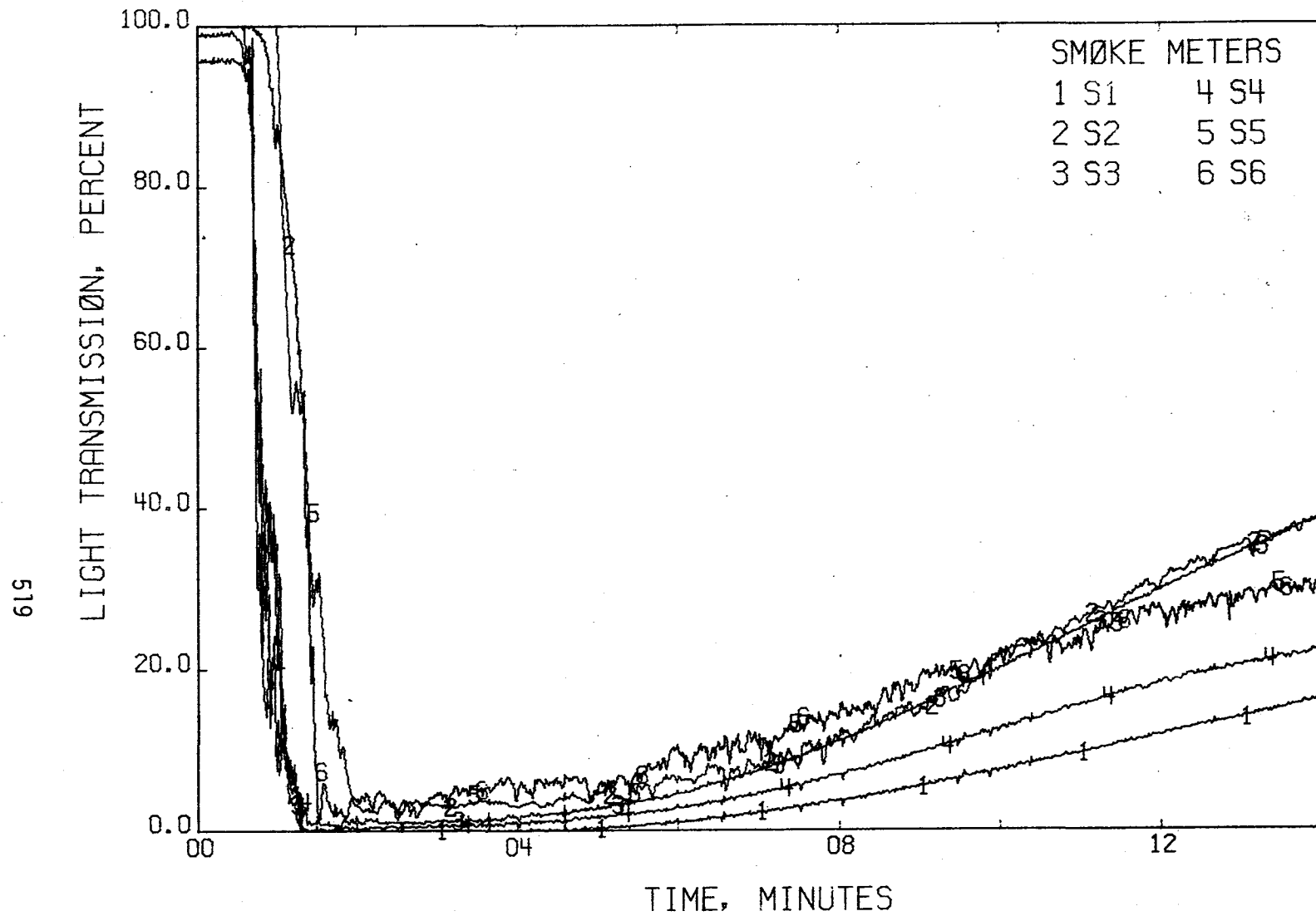


FIGURE 403 . - LIGHT TRANSMISSION  
TEST 19

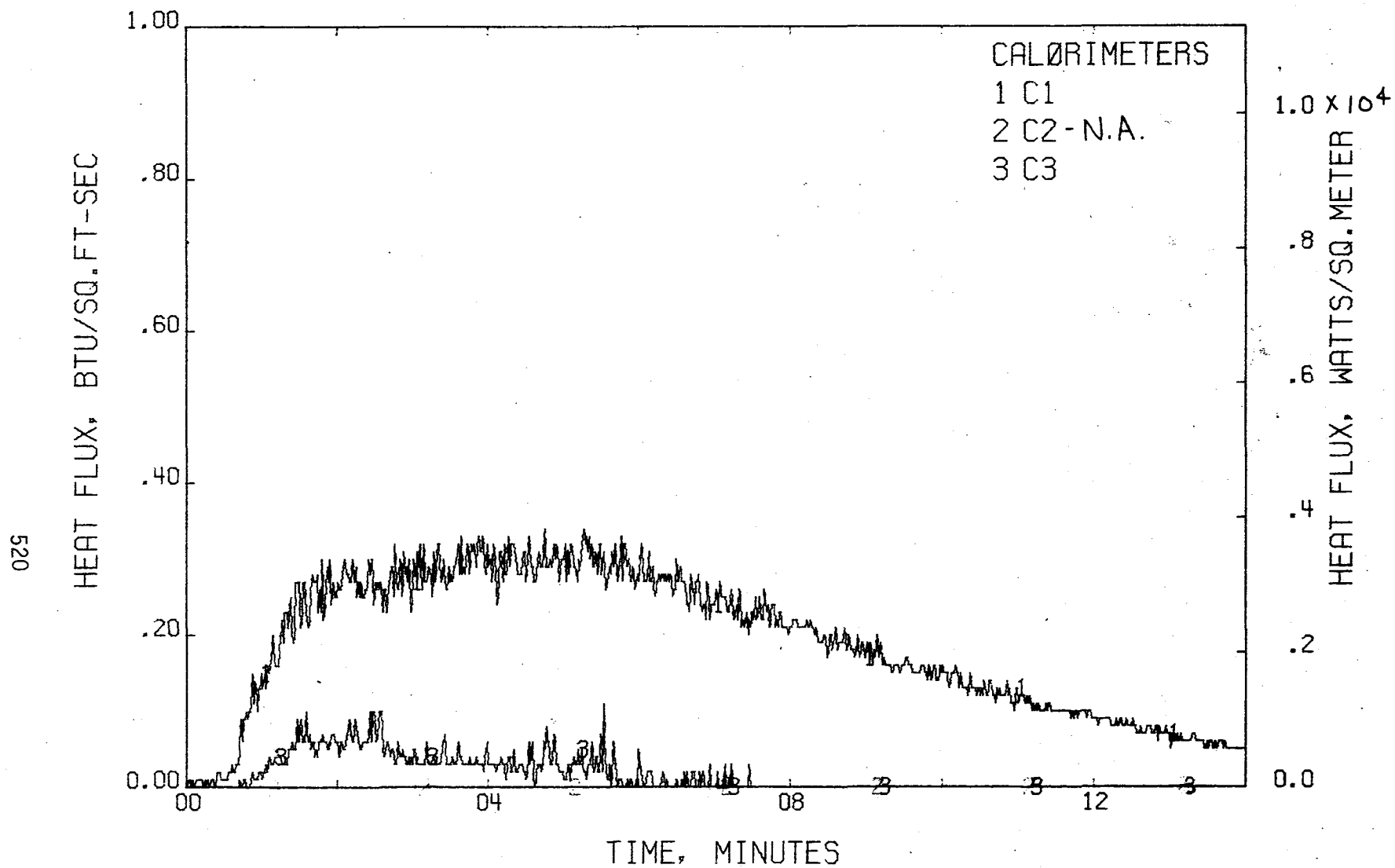


FIGURE 404 . - HEAT FLUX, AFT  
TEST 19



521

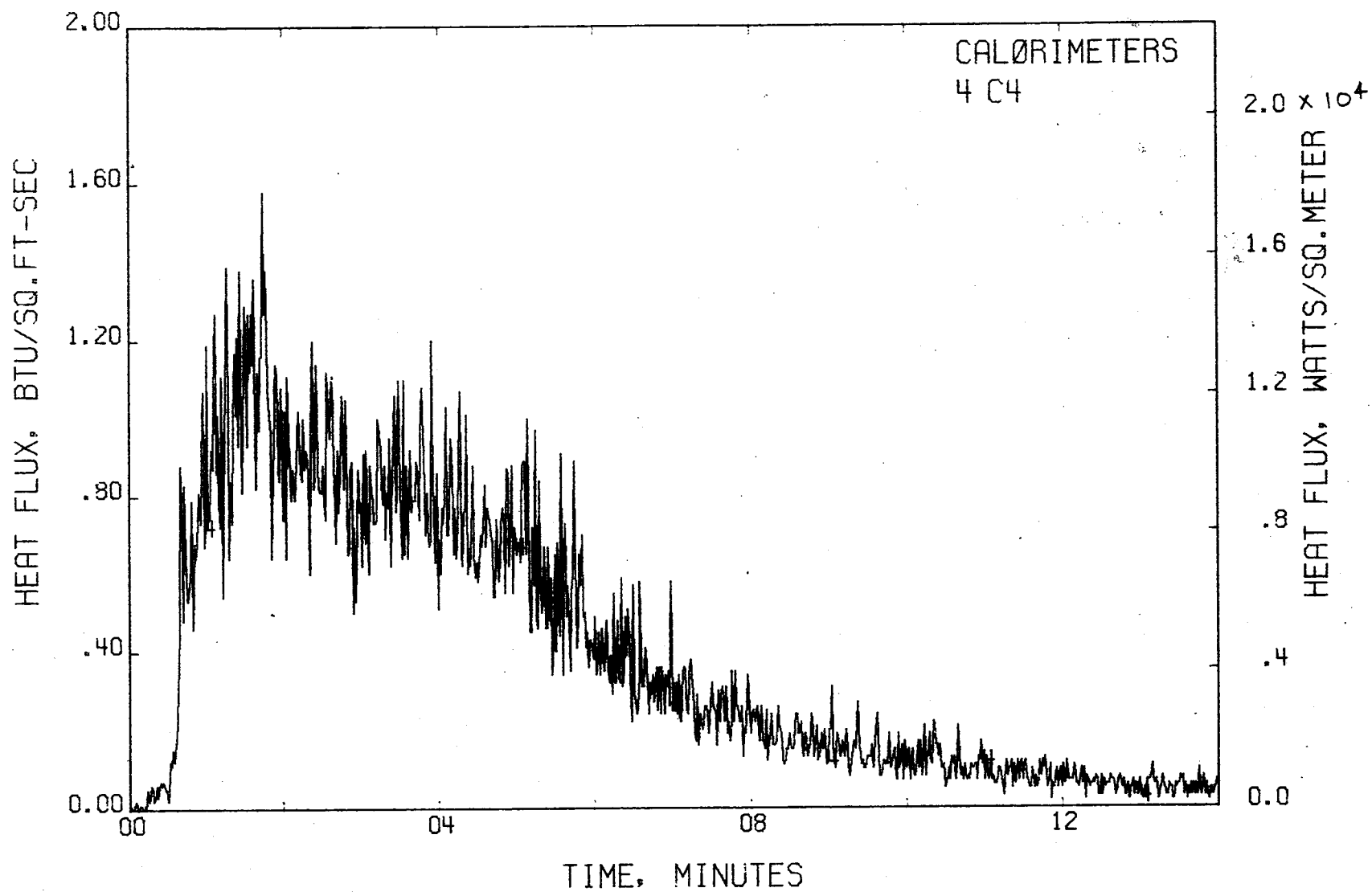


FIGURE 405 . - HEAT FLUX, MIDSECTION  
TEST 19

522

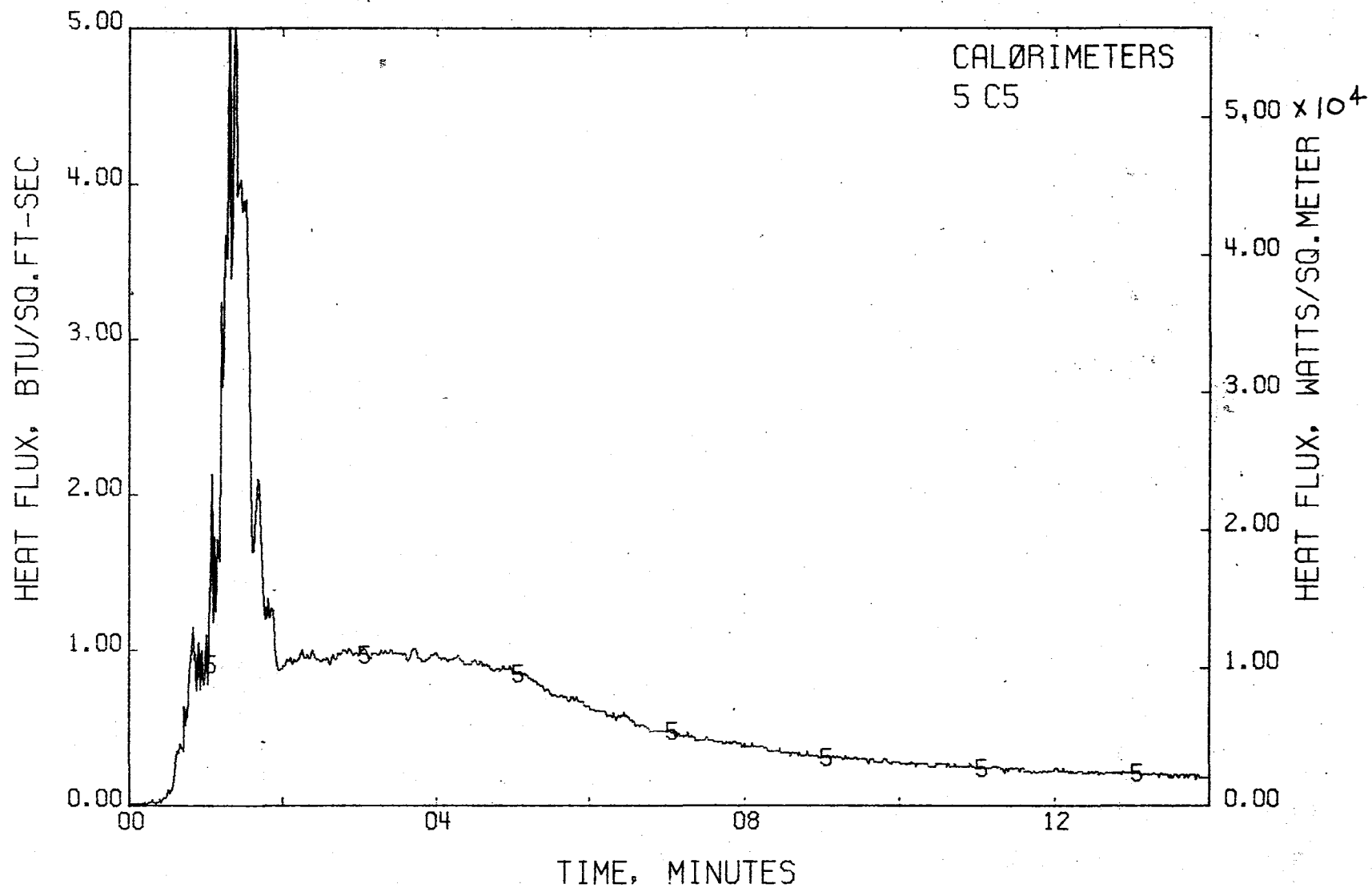


FIGURE 405 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 19

523

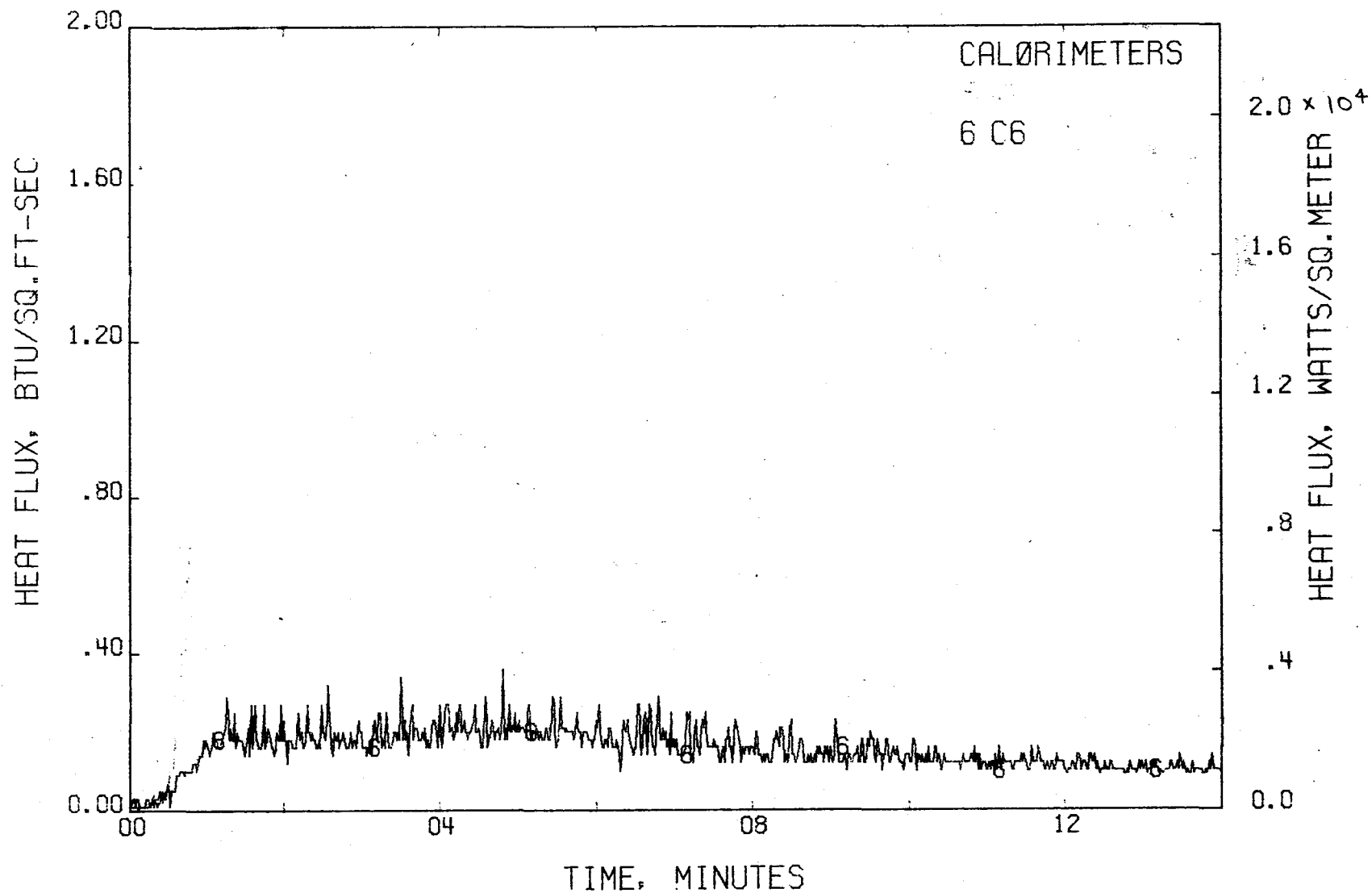


FIGURE 405 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 19

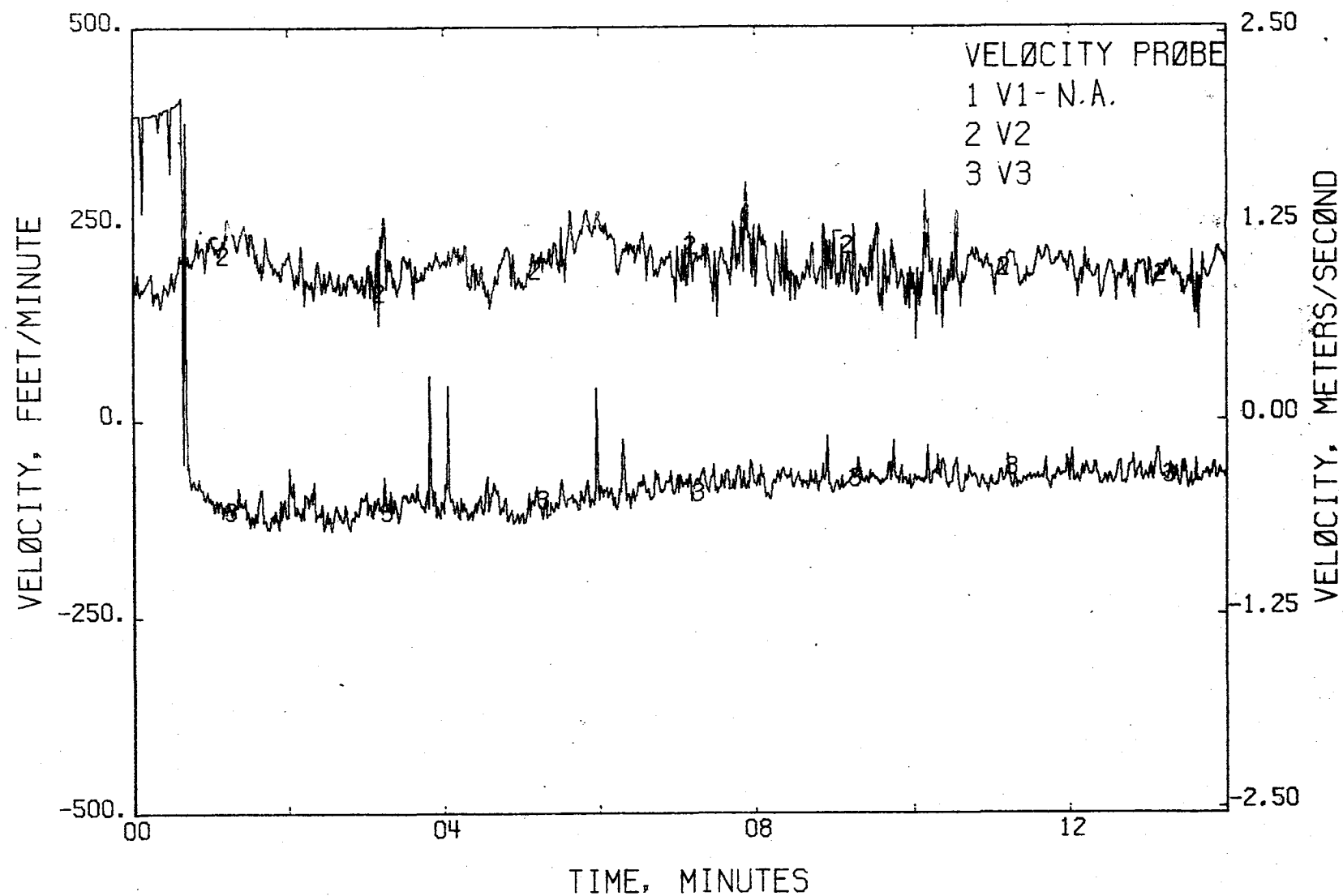


FIGURE 406 . - AIR VELOCITY  
TEST 19

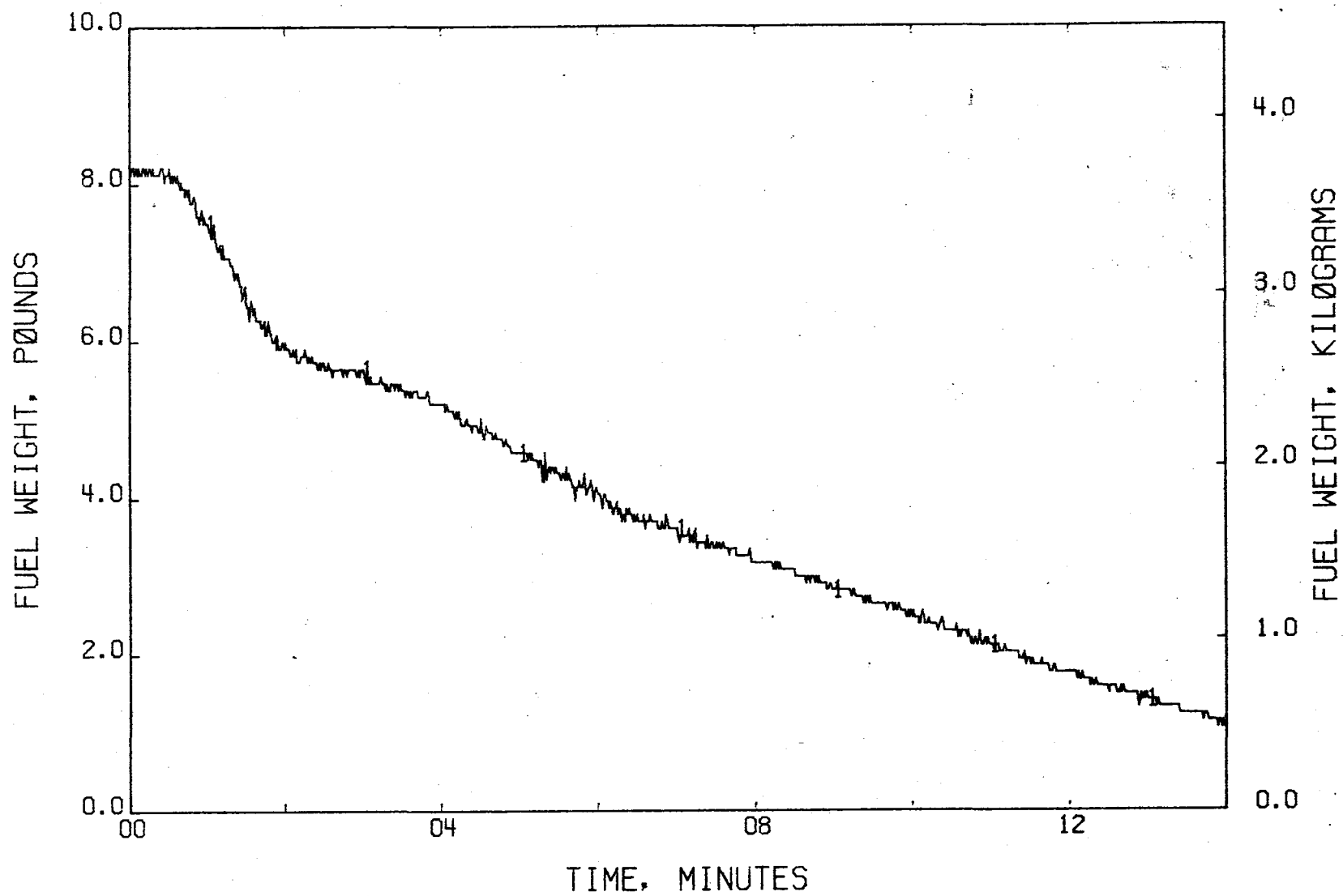


FIGURE 407 . - FUEL WEIGHT LOSS  
TEST 19

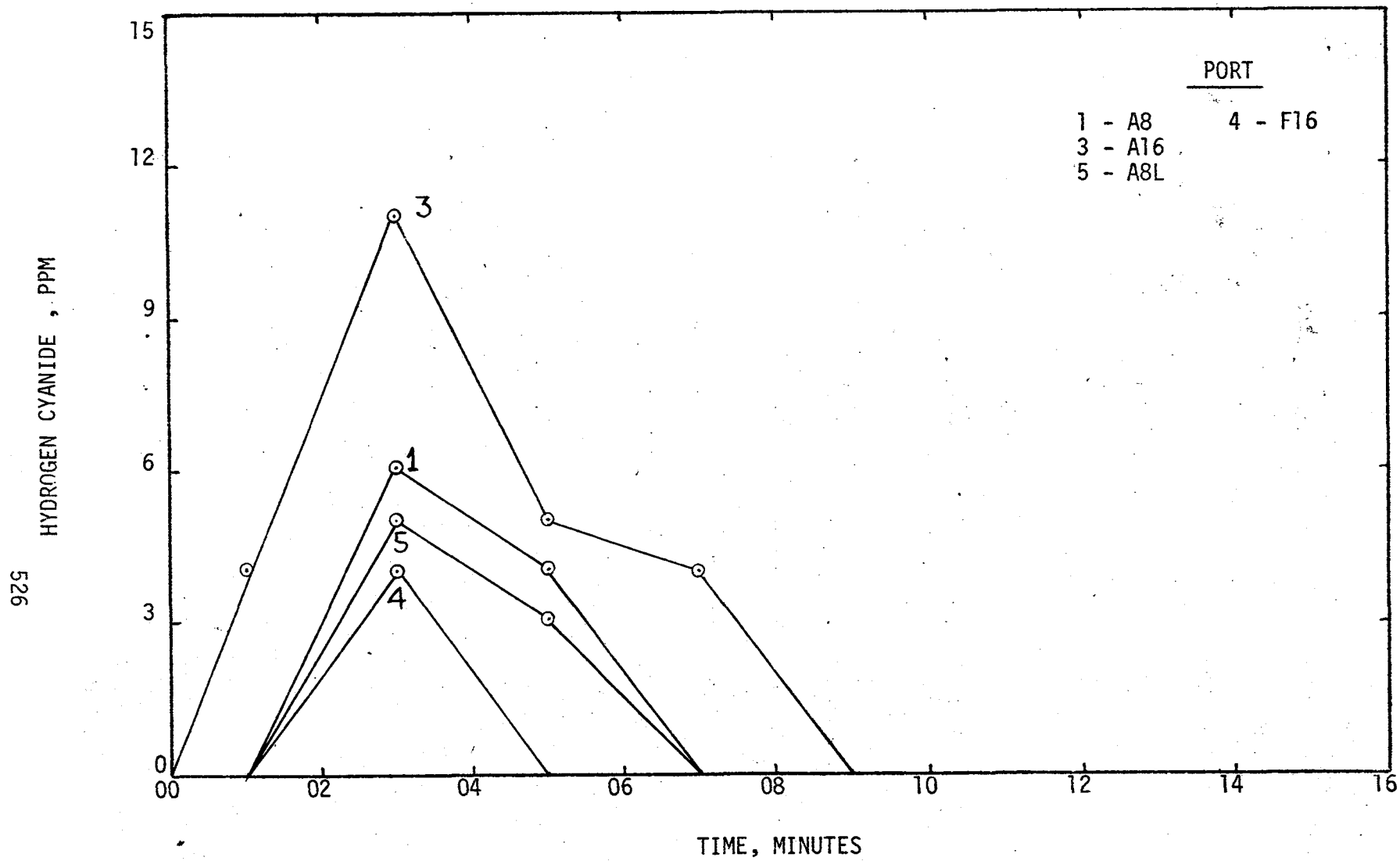


FIGURE 408 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 19

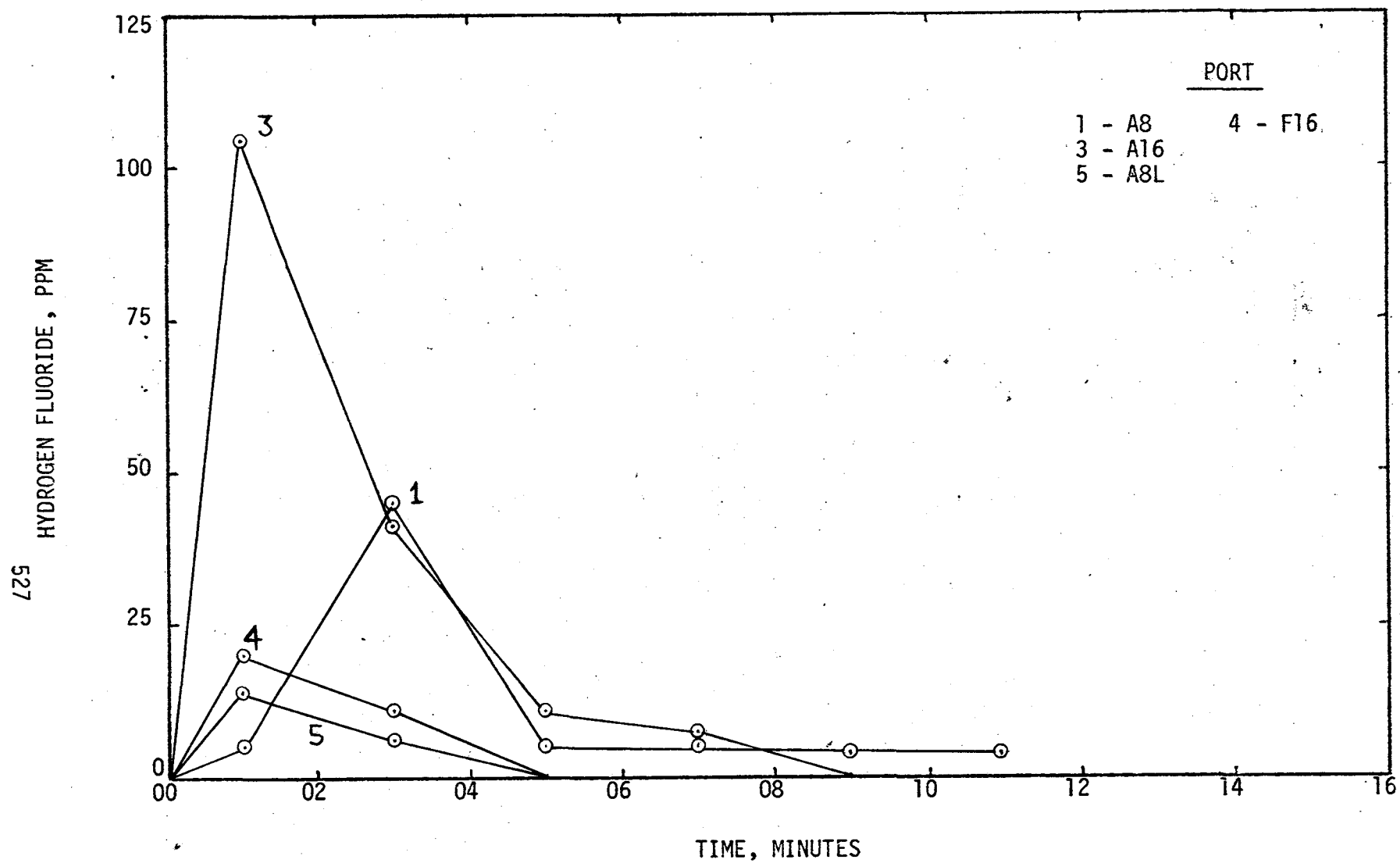


FIGURE 409 : - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 19

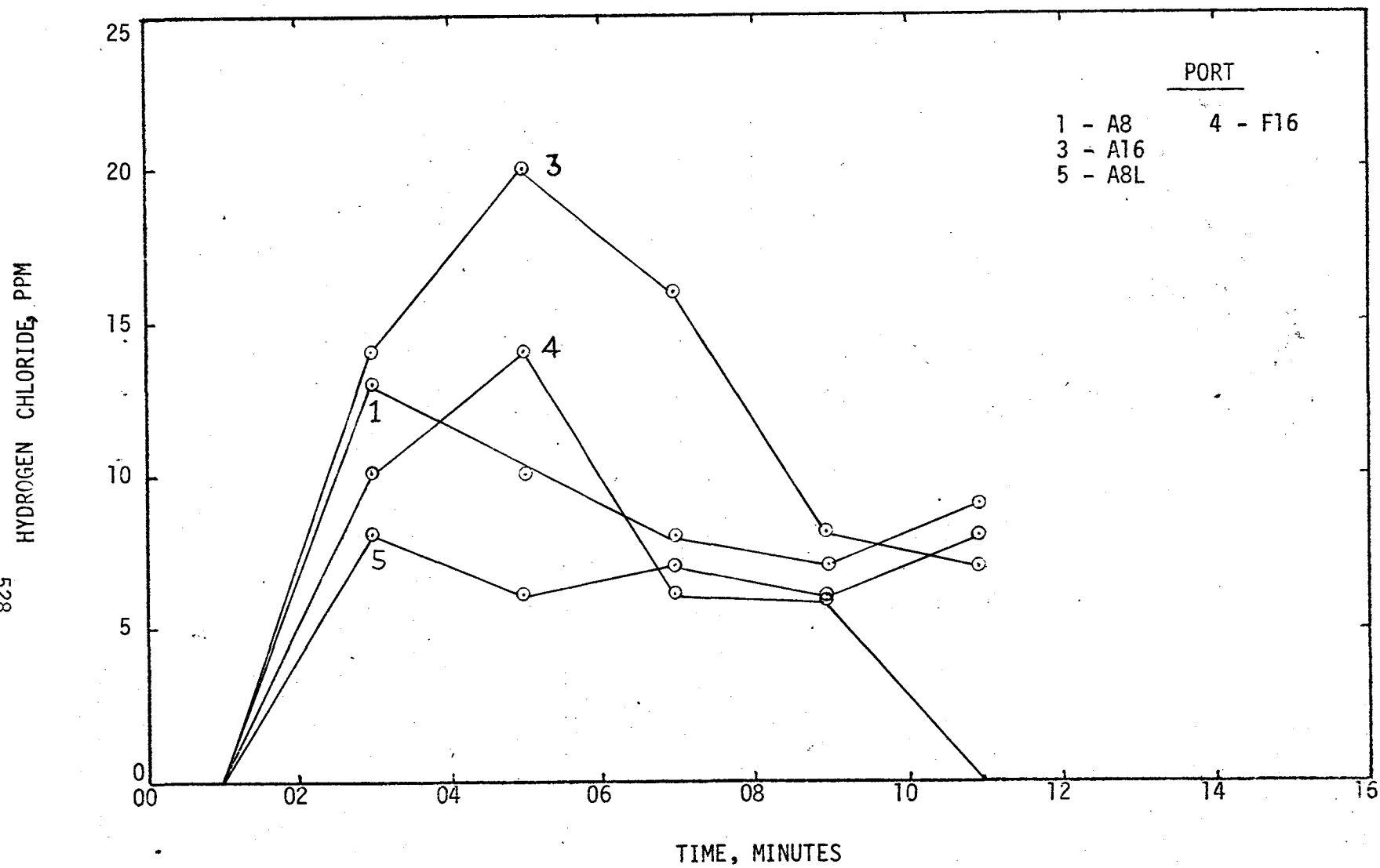


FIGURE 410 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 19



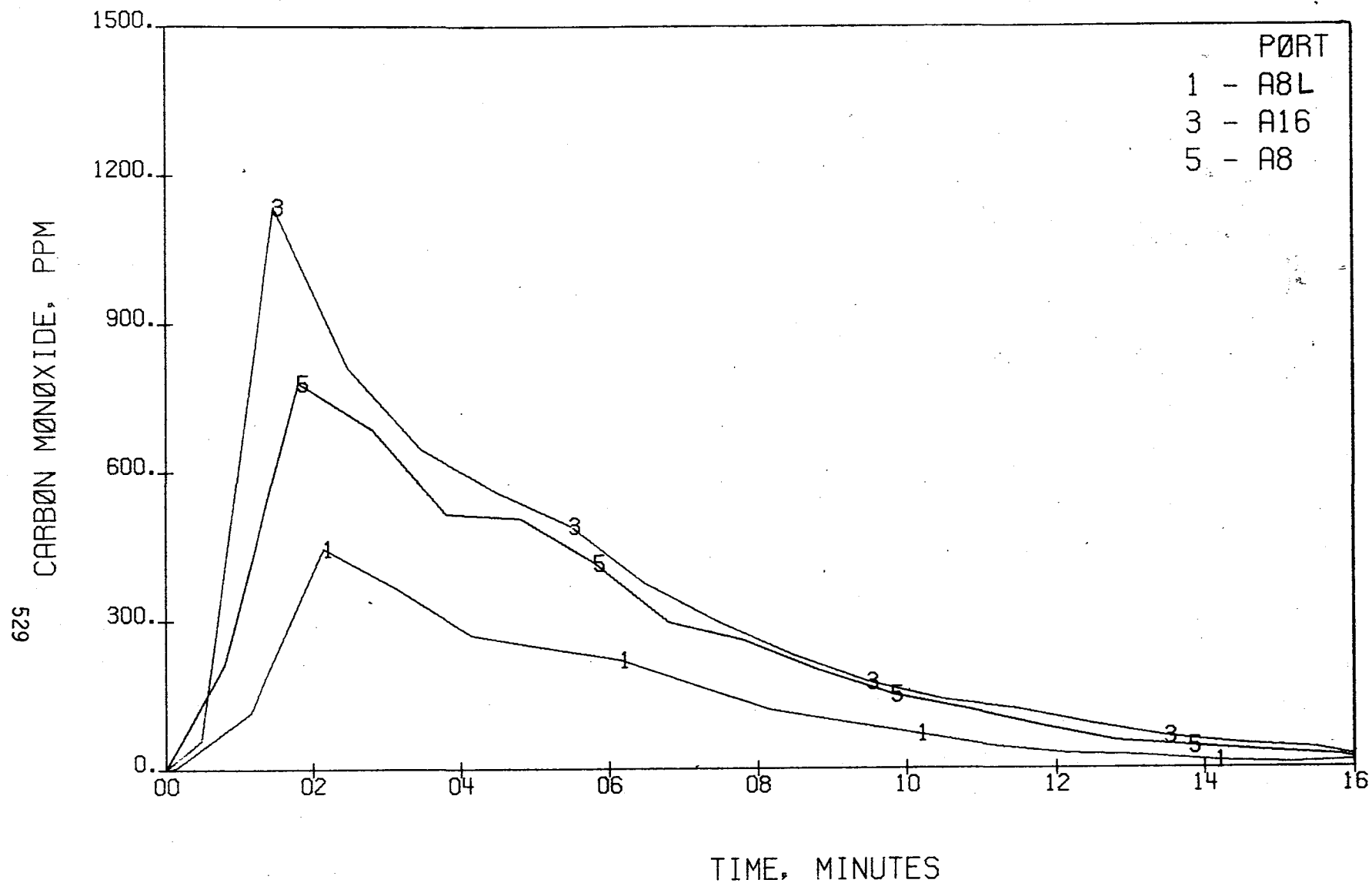


FIGURE 411. - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 19

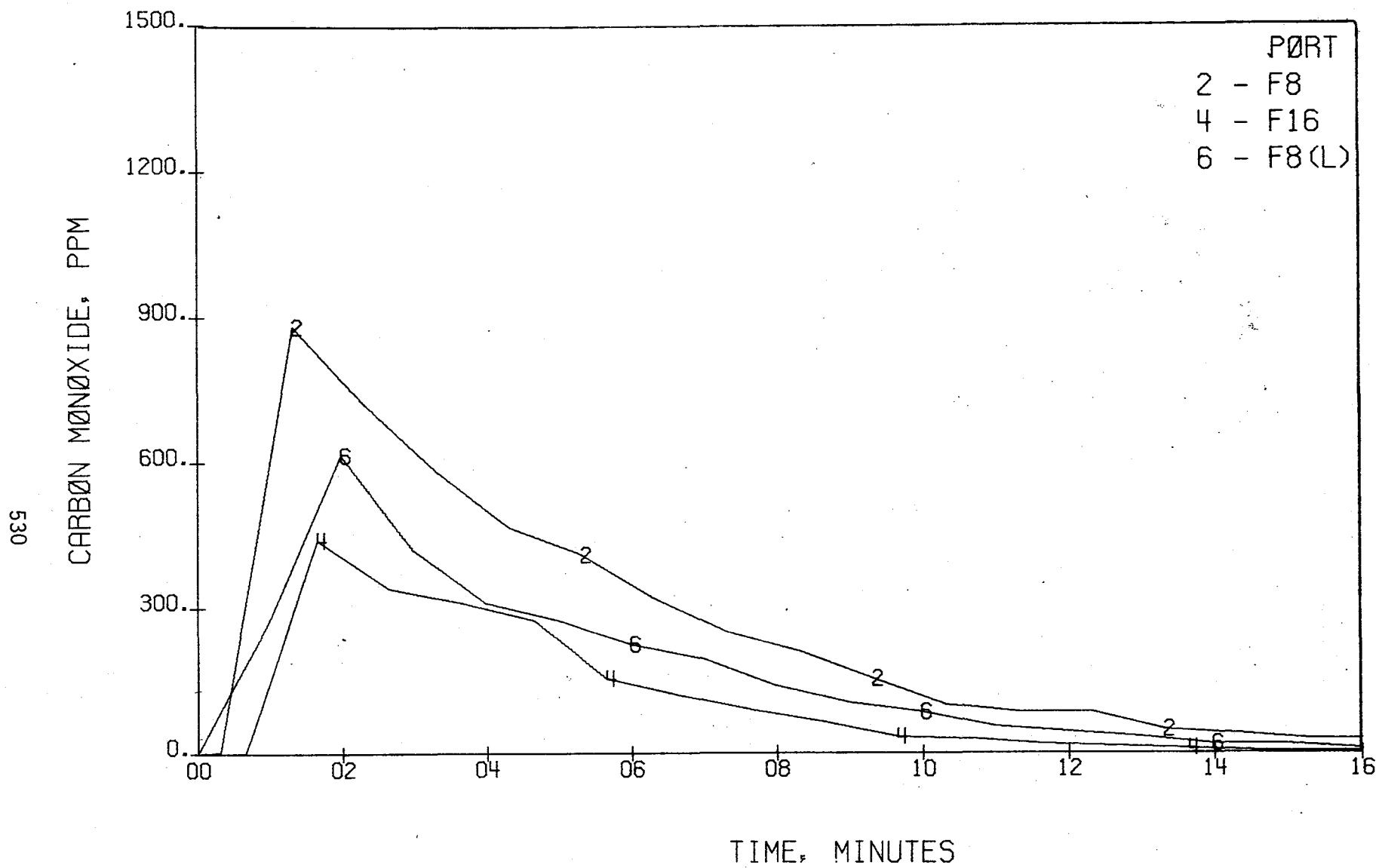


FIGURE 412, - CARBON MONOXIDE CONCENTRATIONS, FØRE  
TEST 19

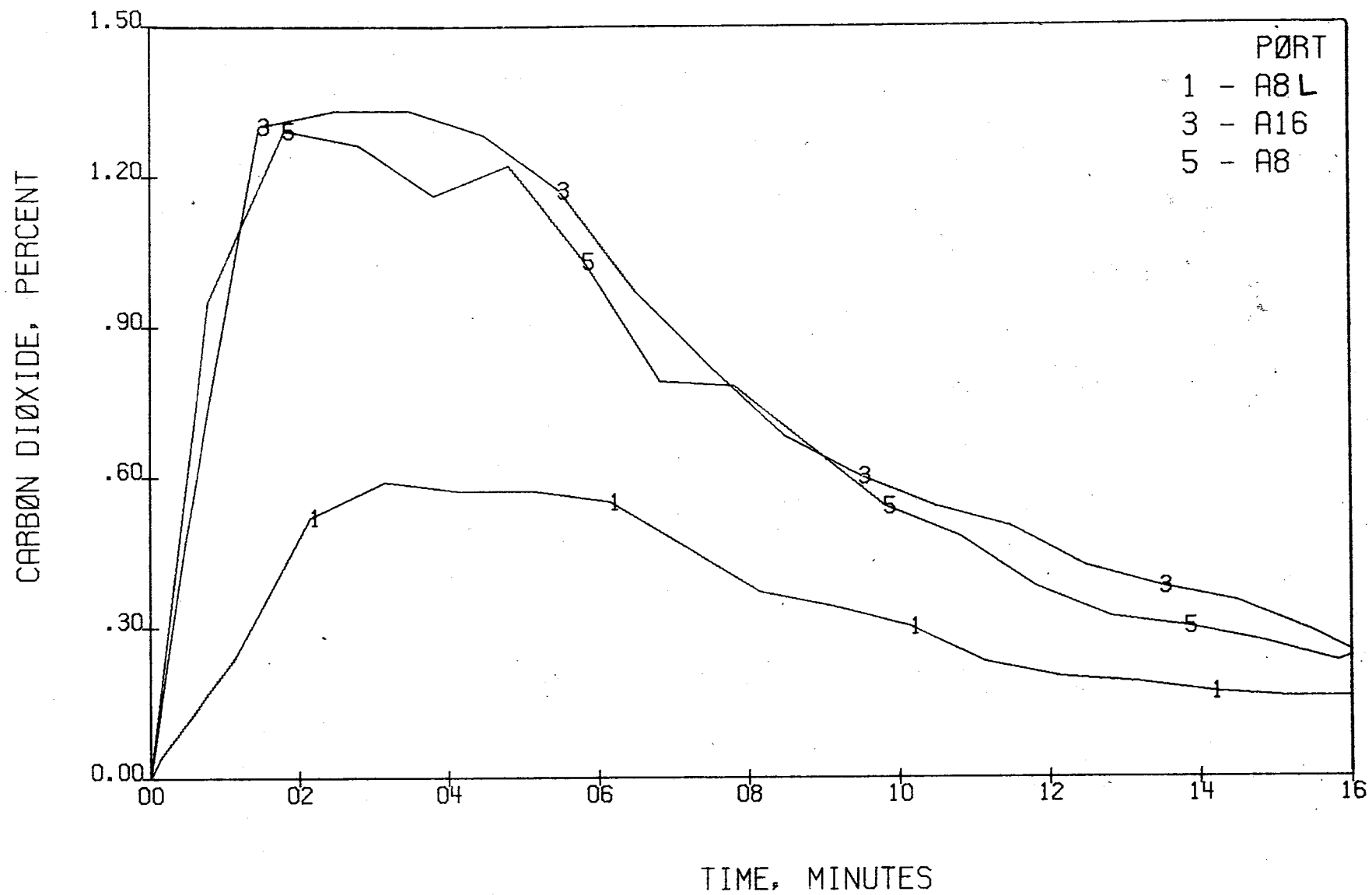


FIGURE 413 .- CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 19

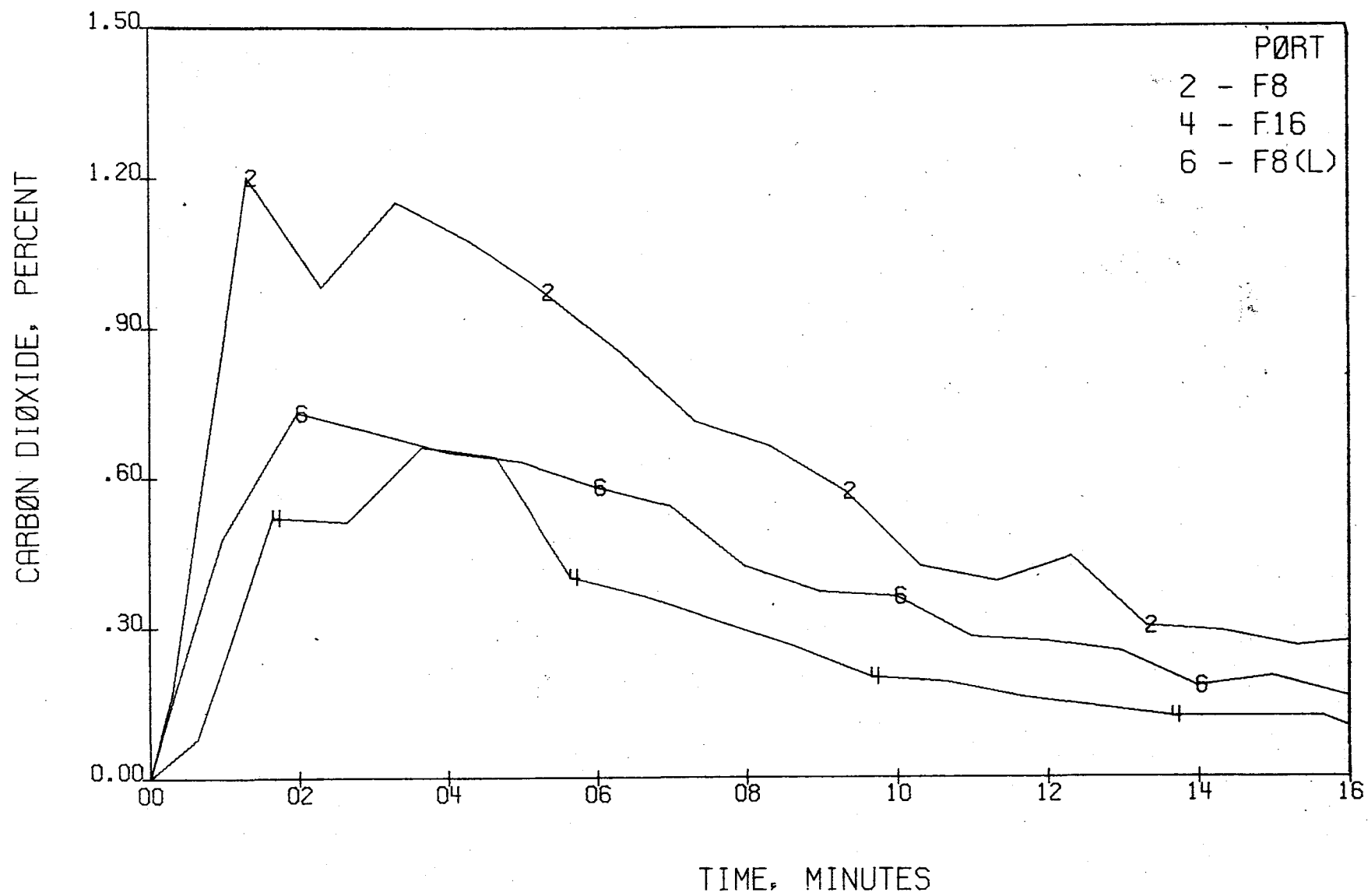


FIGURE 414 . - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 19

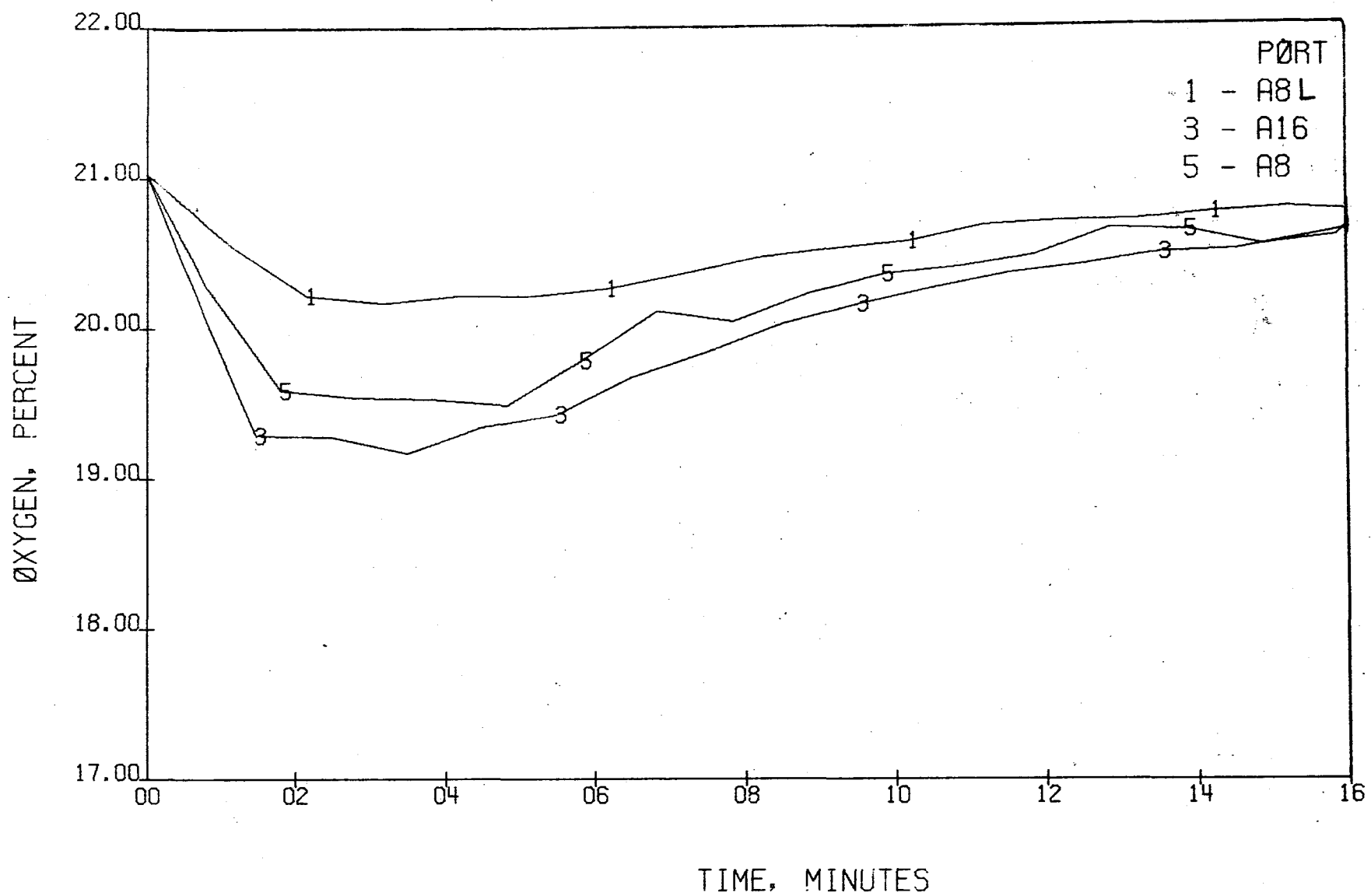


FIGURE 415 . - OXYGEN CONCENTRATIONS, AFT  
TEST 19

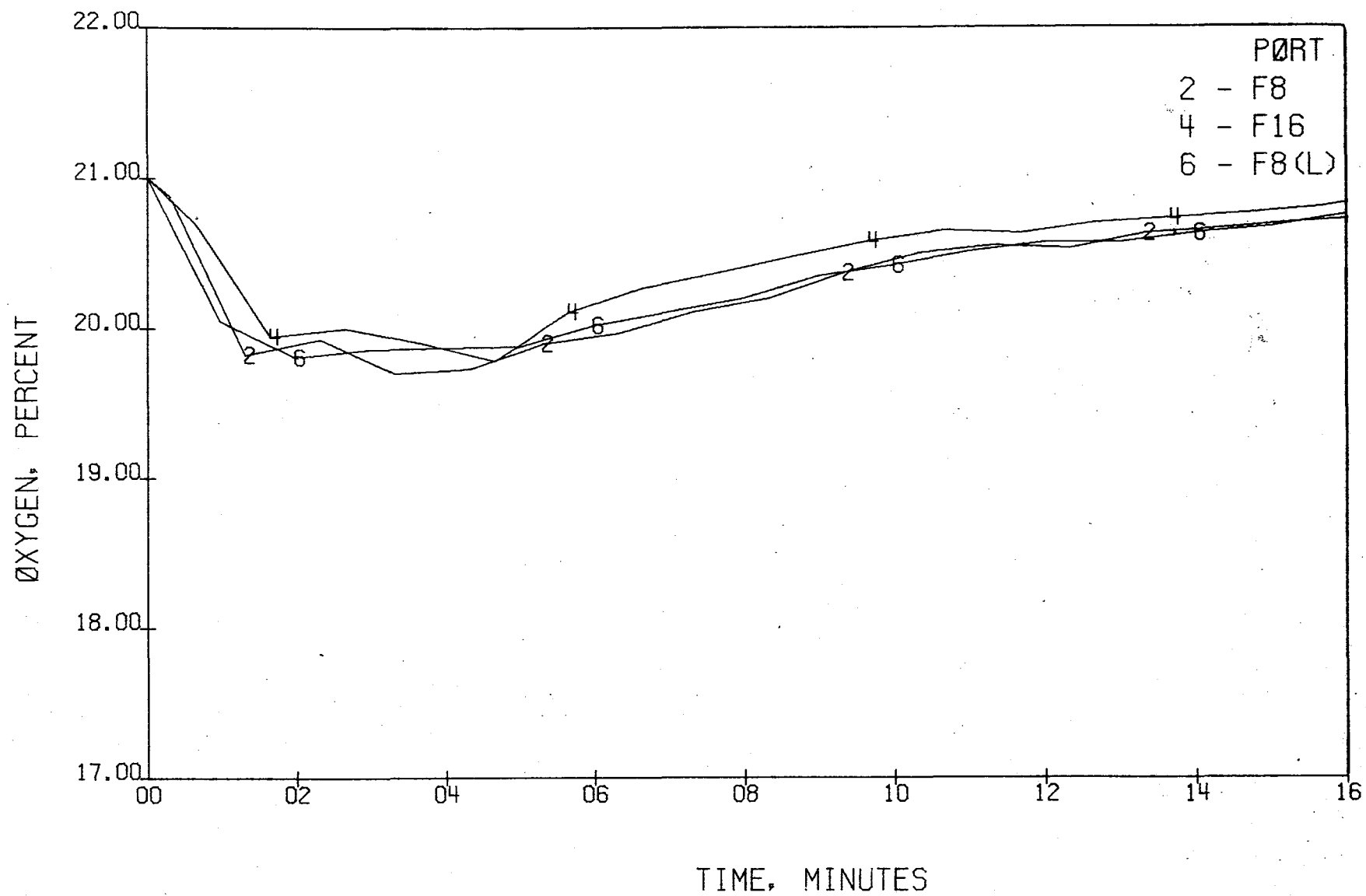


FIGURE 416 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 19

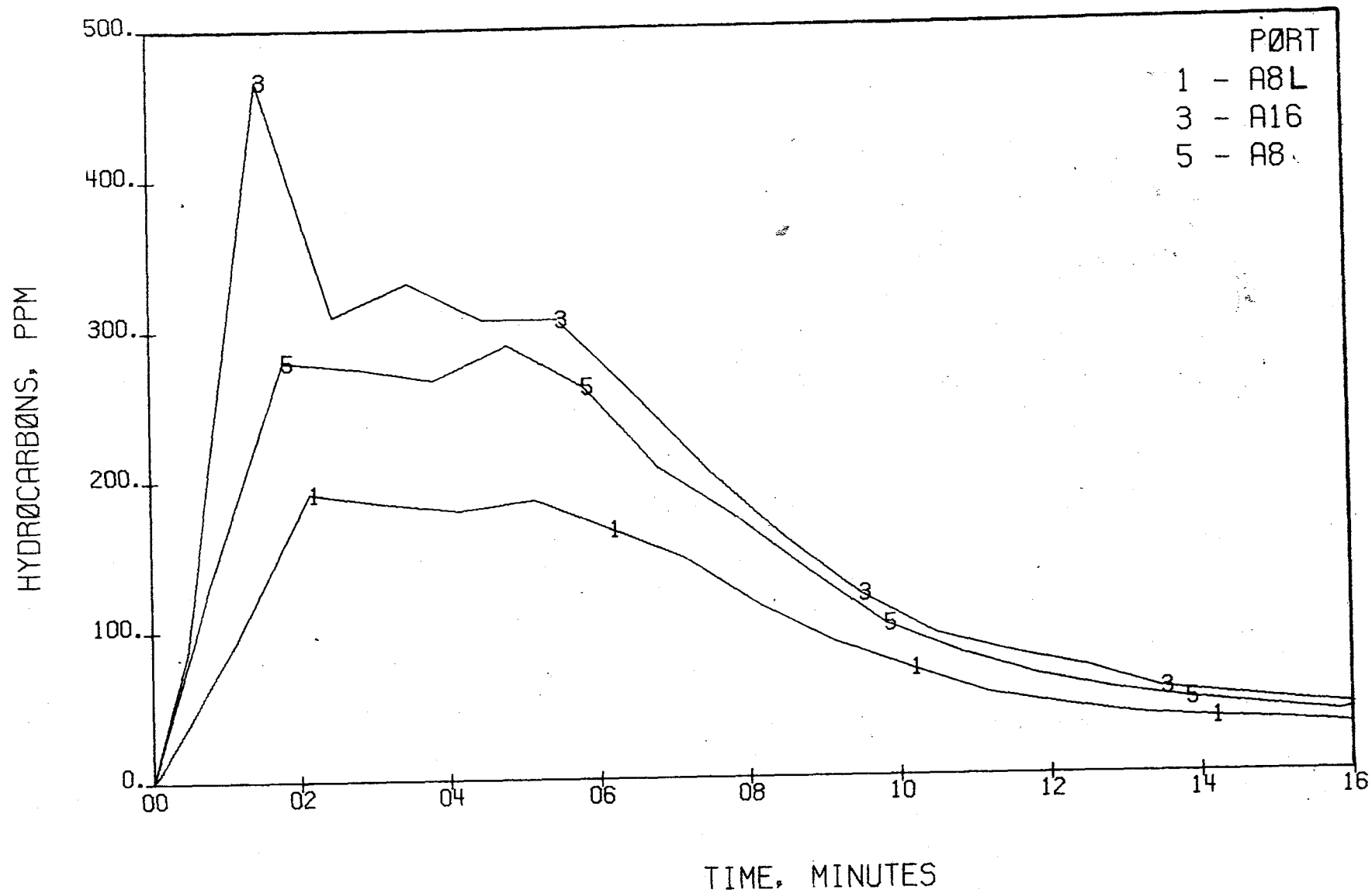


FIGURE 417 . - HYDROCARBONS CONCENTRATIONS, AFT TEST 19

536

HYDROCARBONS, PPM

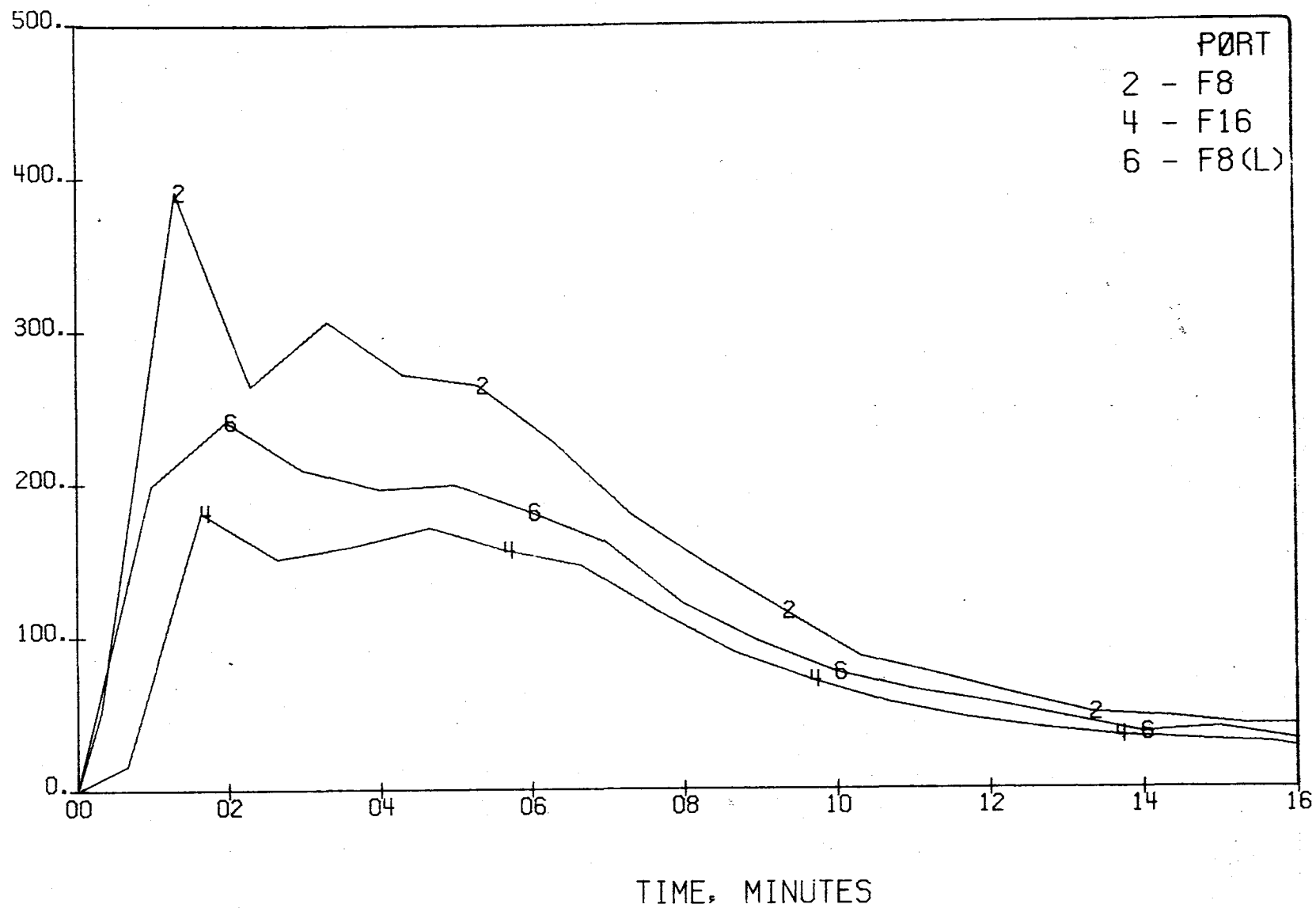


FIGURE 418 .- HYDROCARBONS CONCENTRATIONS, FØRE TEST 19



TEST 20

---

PSU, BIN, AND CEILING PANELS

TEST 20

PSU, BIN, AND CEILING PANELS

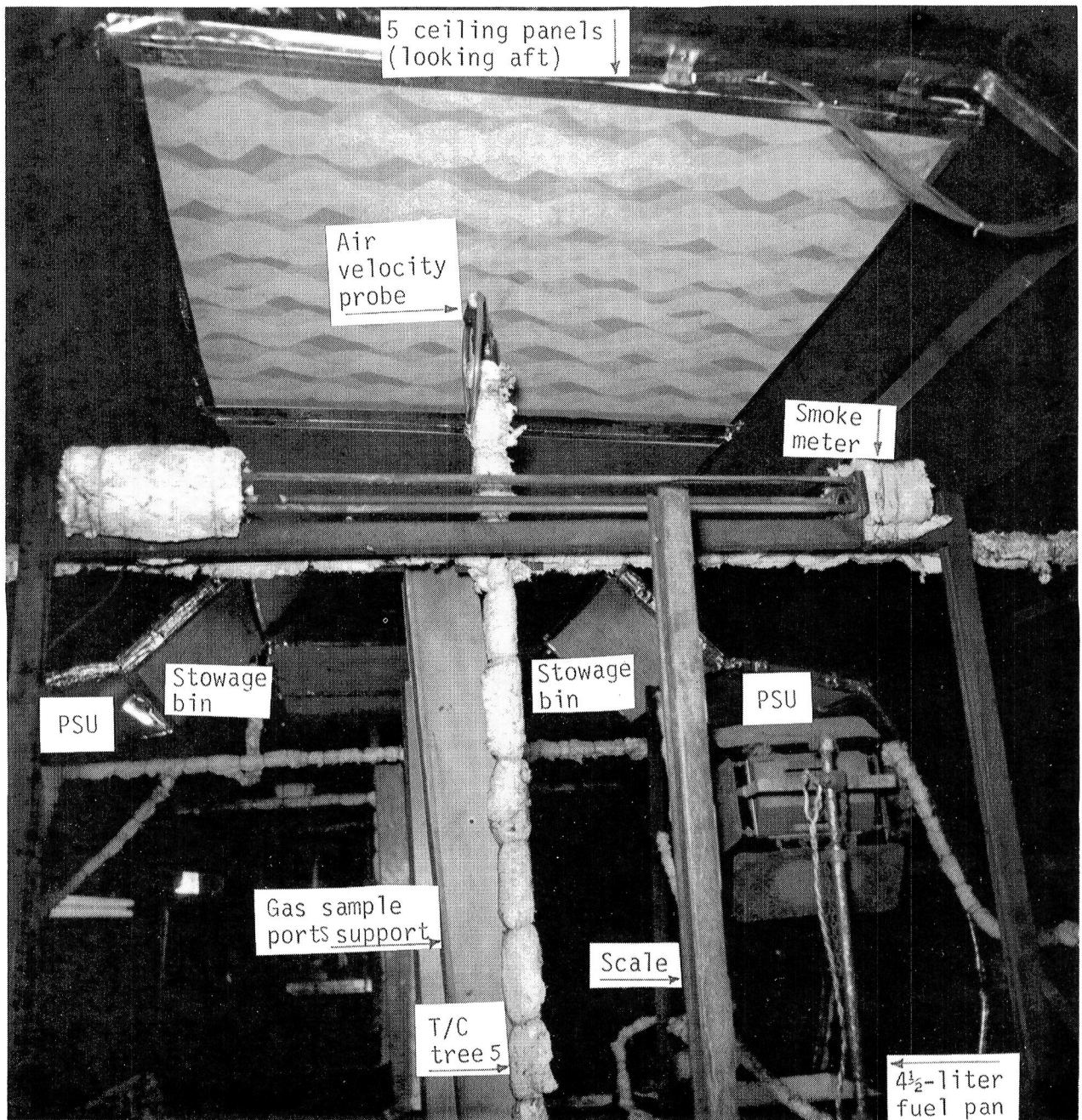


FIGURE 419. - PRE-TEST CONFIGURATION, TEST 20

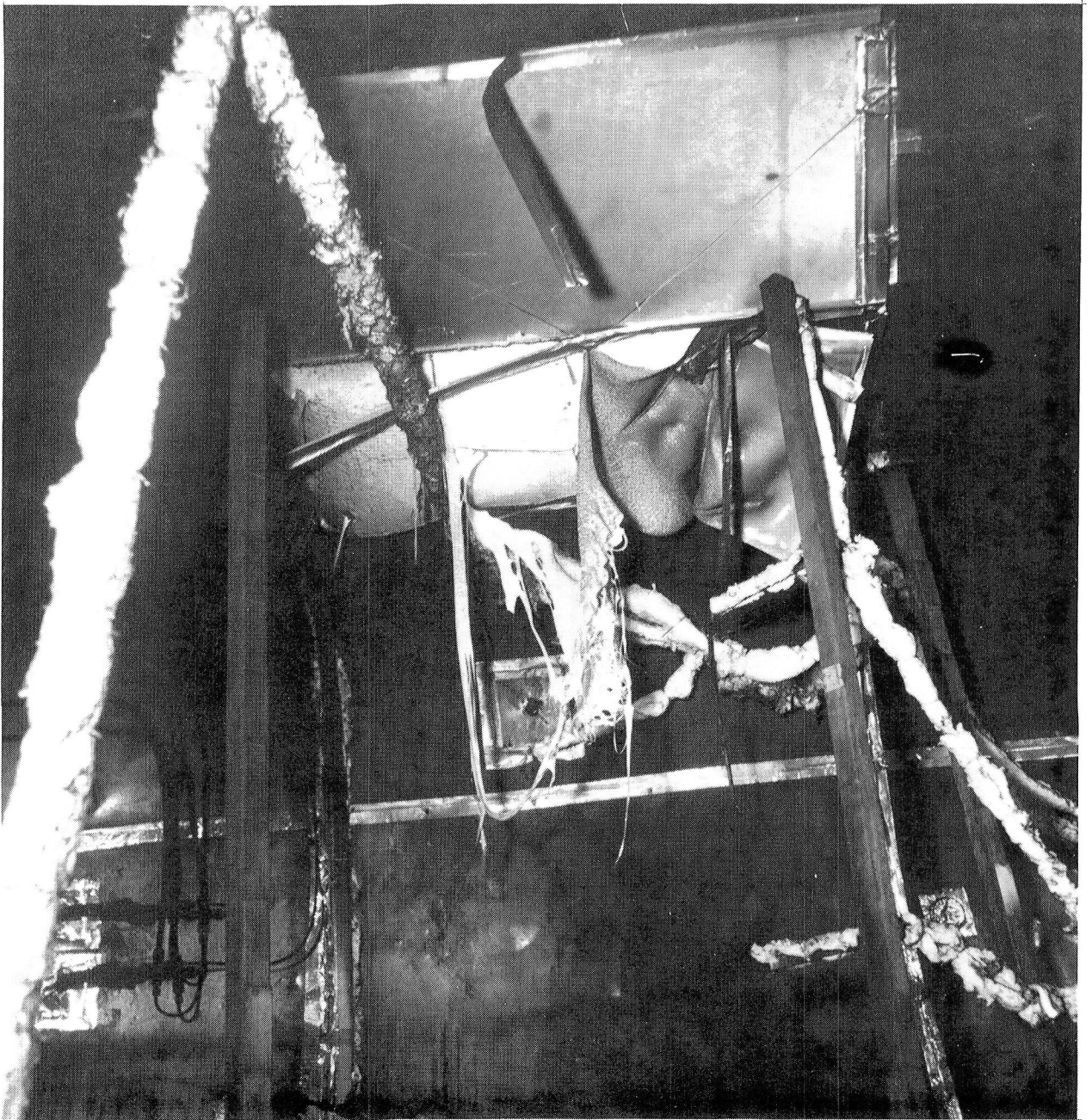


FIGURE 420. - POST-TEST CONFIGURATION, TEST 20





FIGURE 421 . - FIRE DURING TEST 20

541

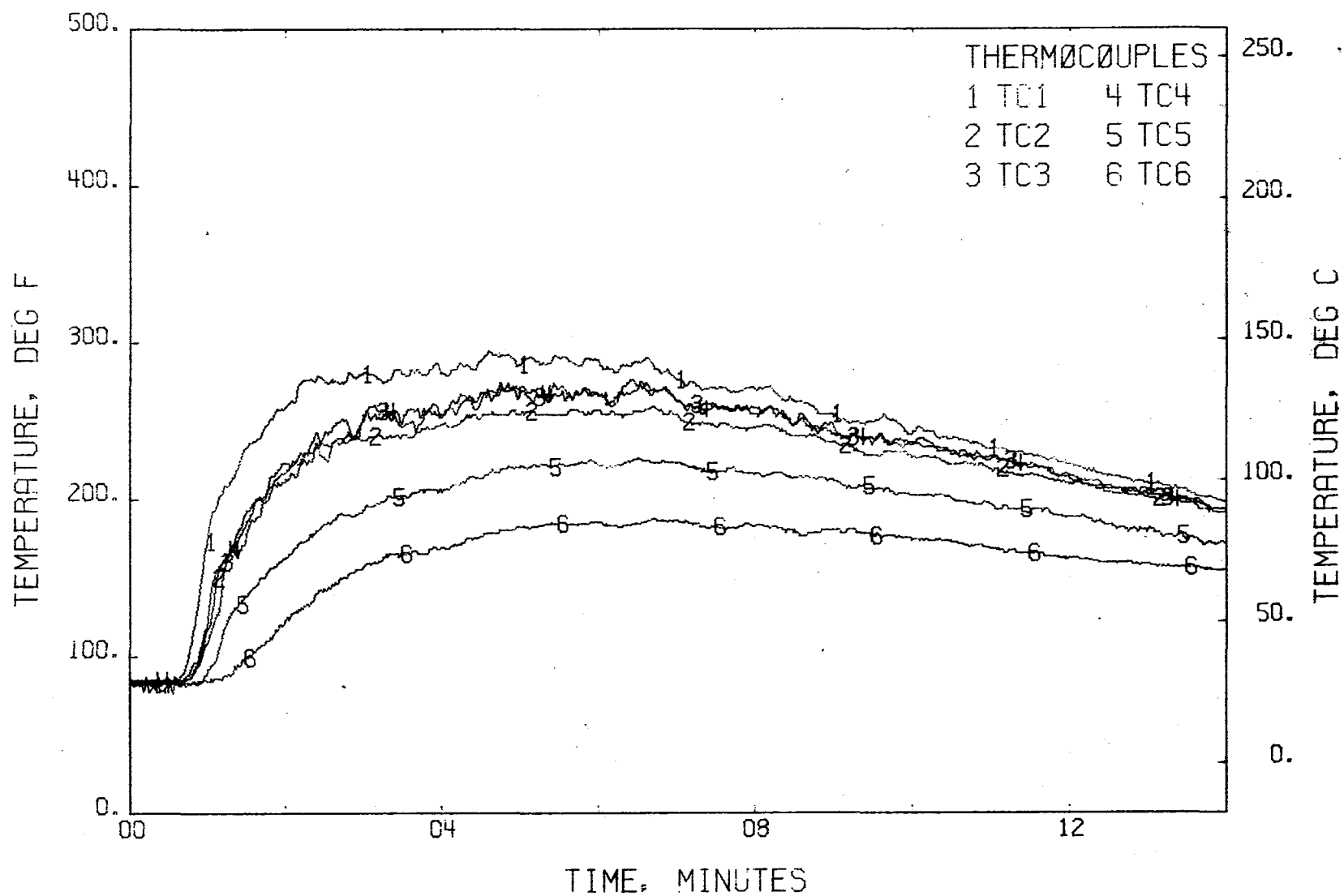


FIGURE 422 . - TEMPERATURES, T/C TREE 1  
TEST 20

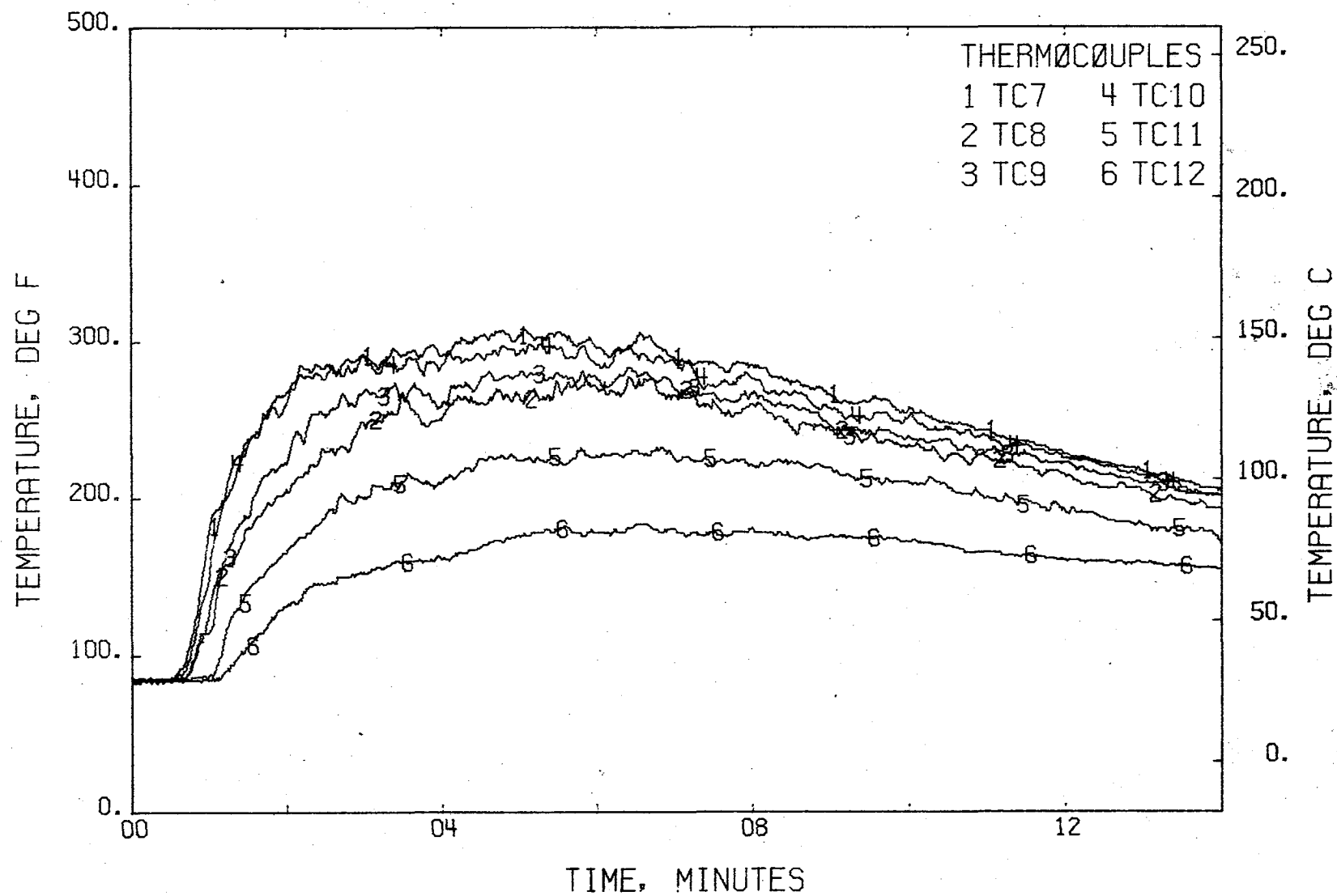


FIGURE 423 . - TEMPERATURES, T/C TREE 2  
TEST 20

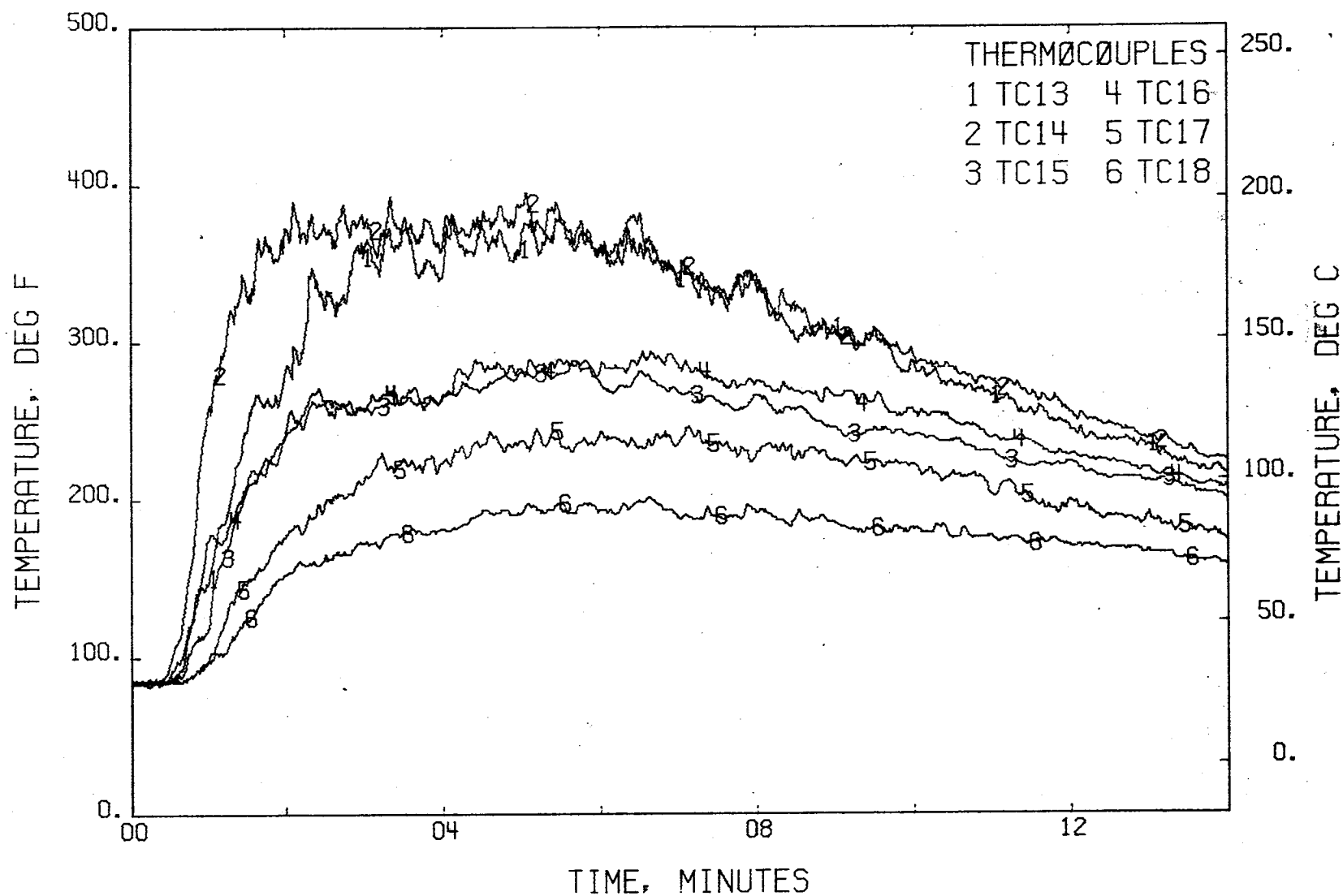


FIGURE 424 . - TEMPERATURES, T/C TREE 3  
TEST 20

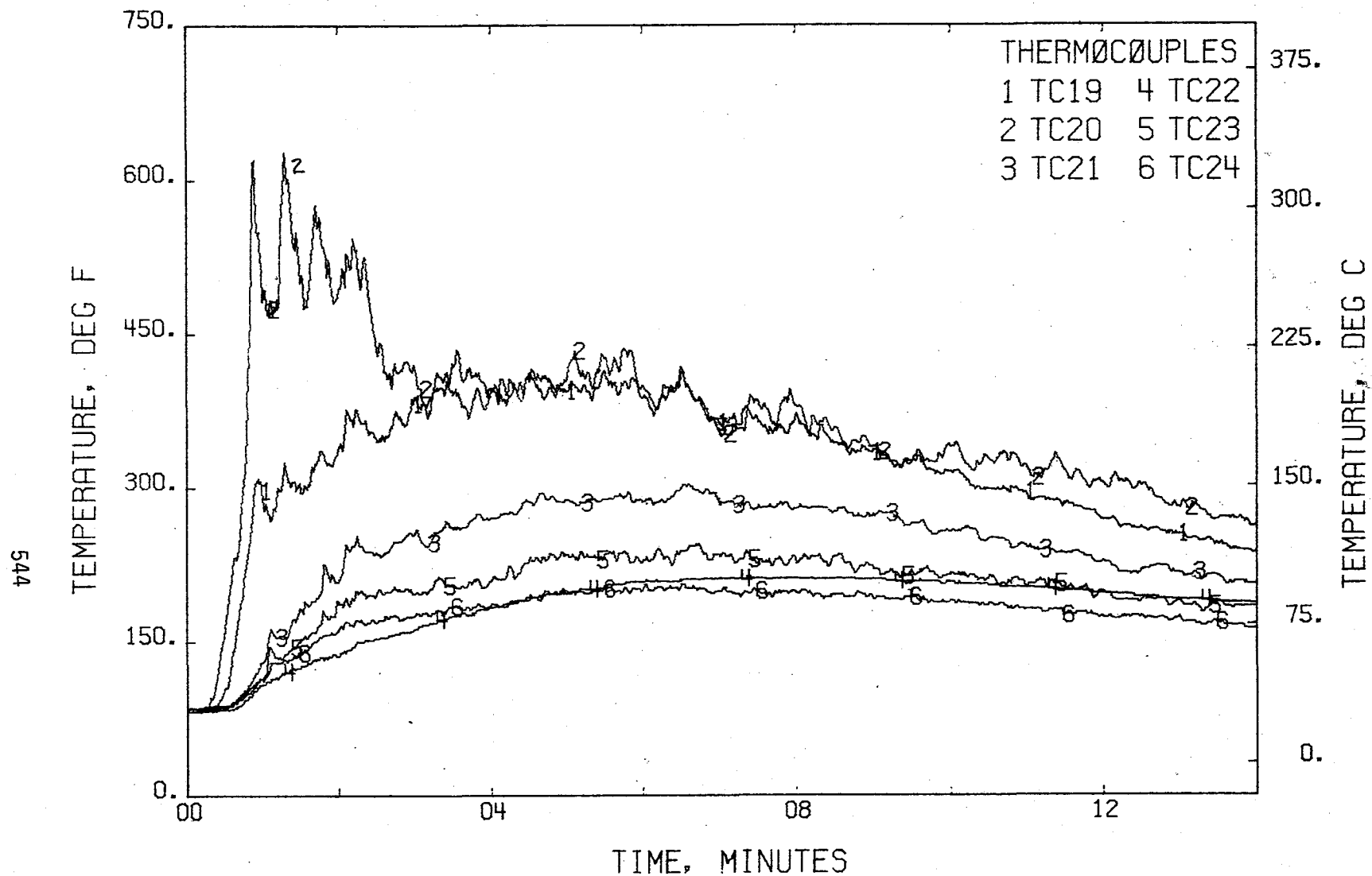


FIGURE 425 . - TEMPERATURES, T/C TREE 4  
TEST 20



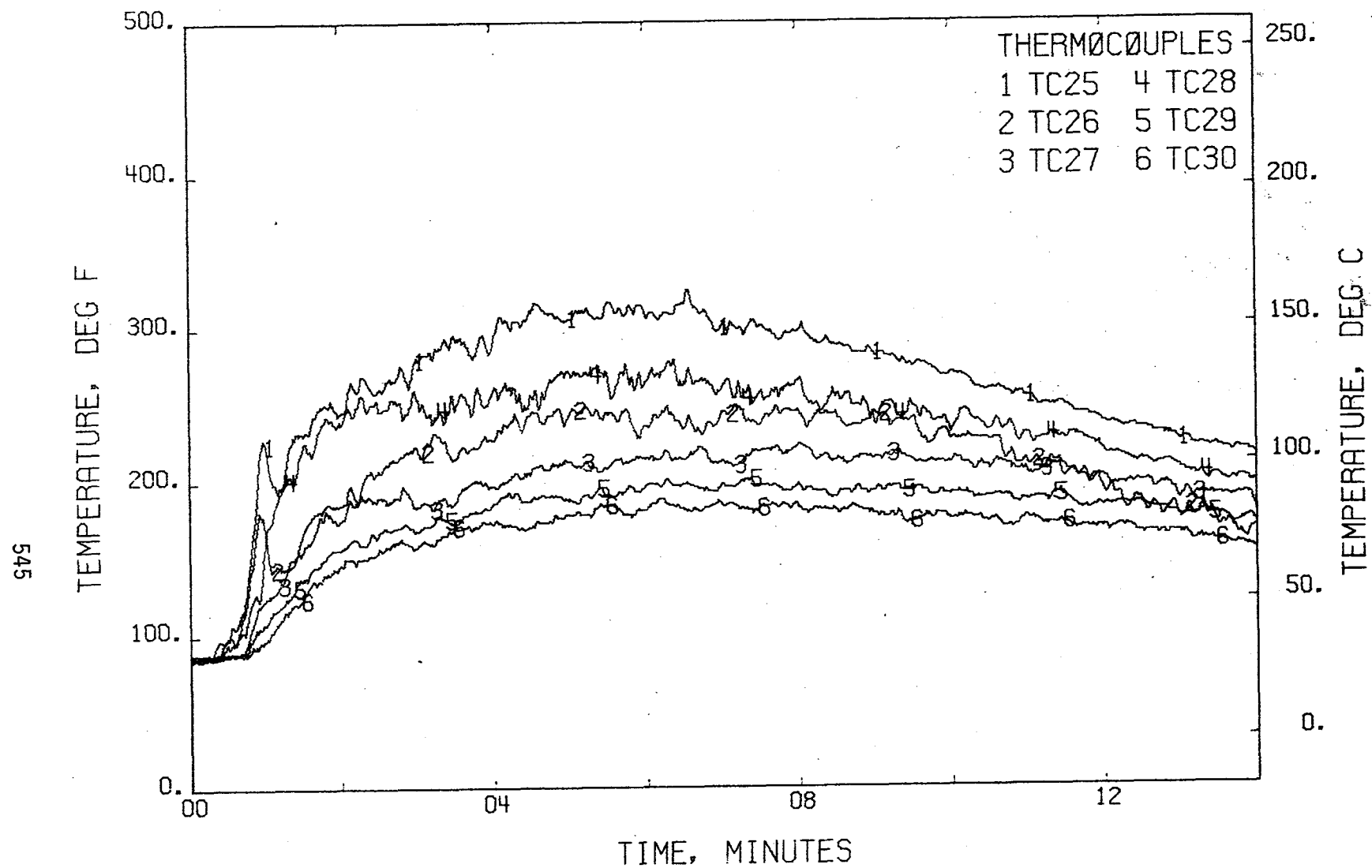


FIGURE 426 . - TEMPERATURES, T/C TREE 5  
TEST 20

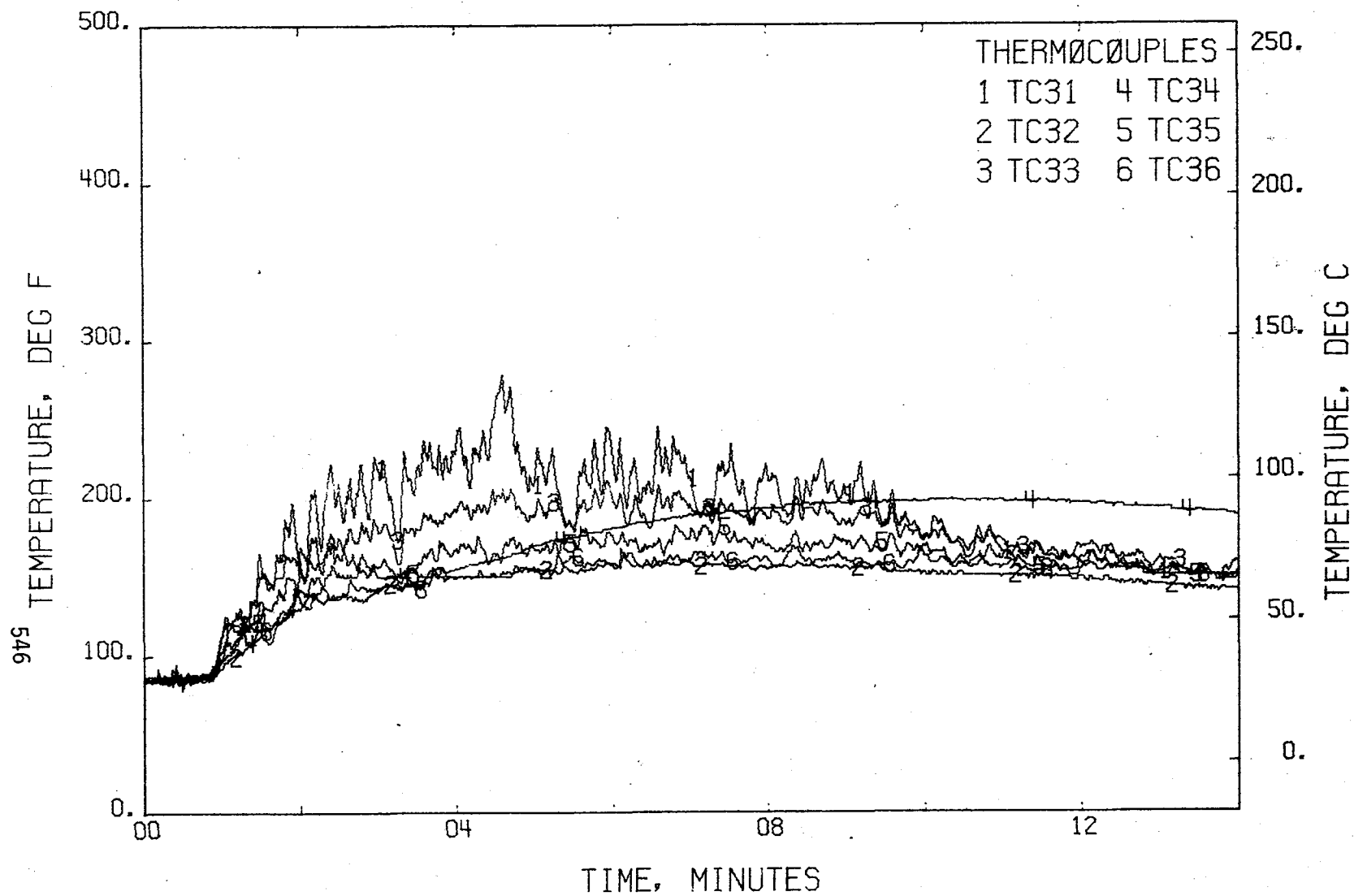


FIGURE 427 . - TEMPERATURES, T/C TREE 6  
TEST 20

547

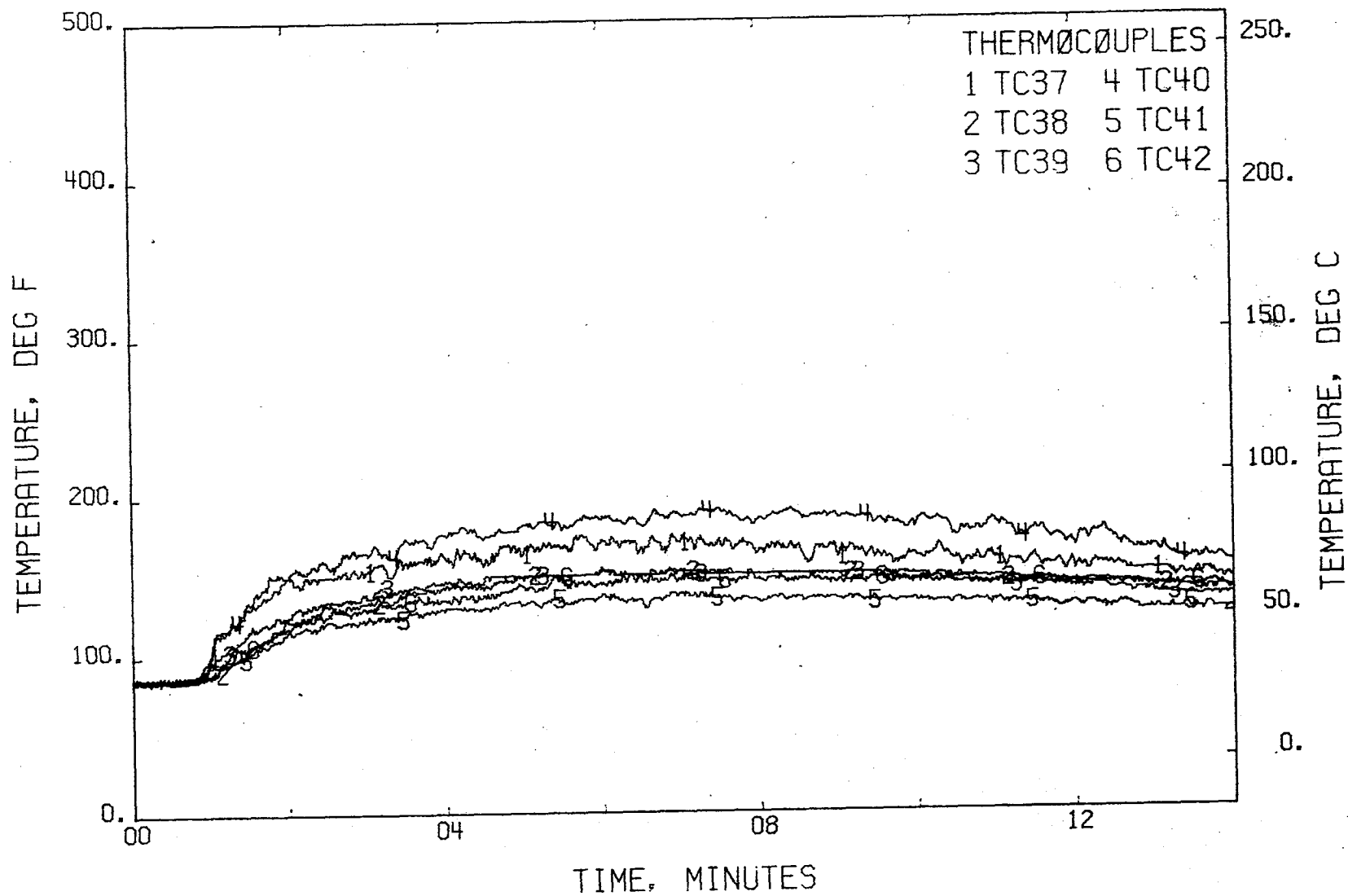


FIGURE 428 . - TEMPERATURES, T/C TREE 7  
TEST 20

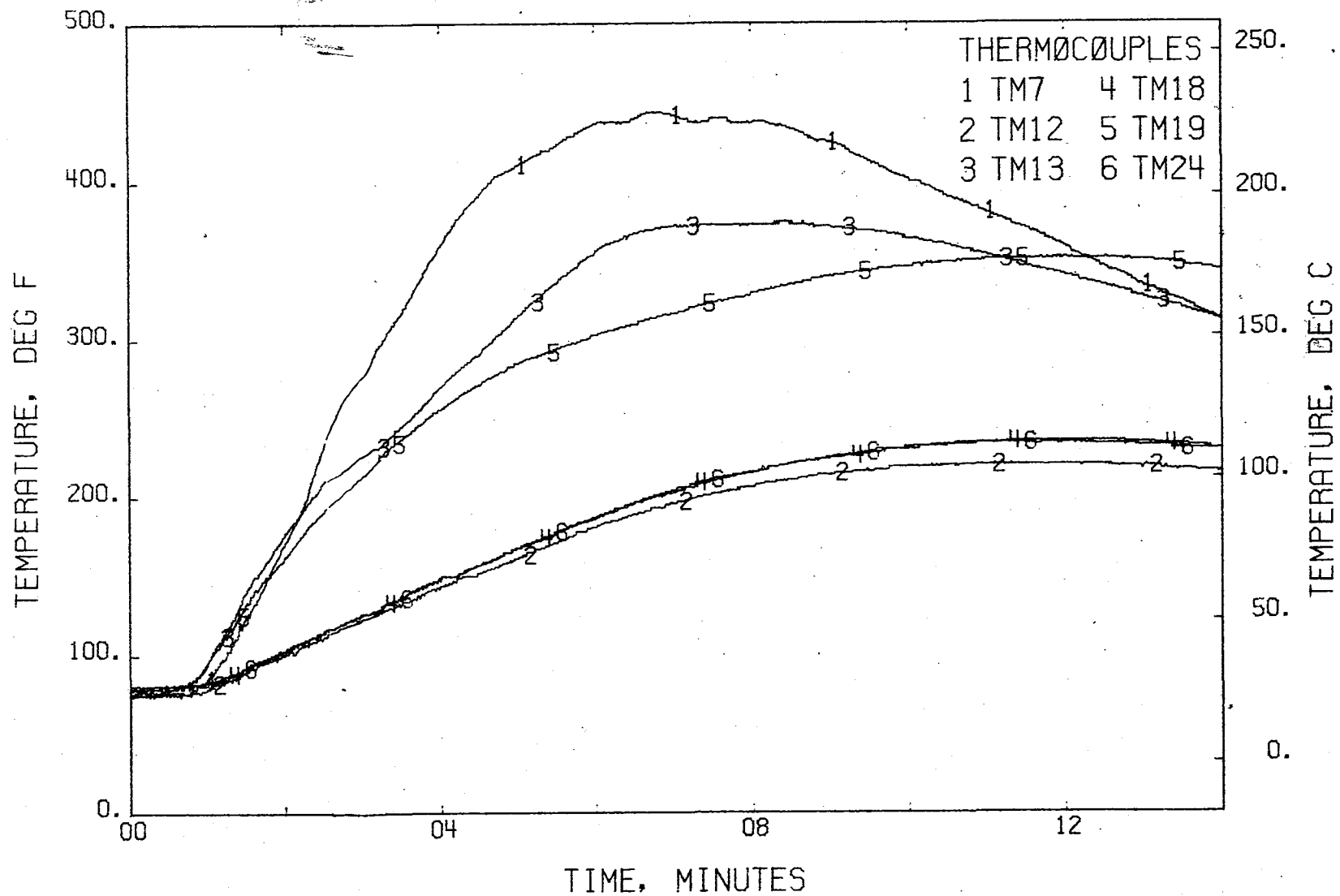


FIGURE 429 . - TEMPERATURES, PSU  
TEST 20

549

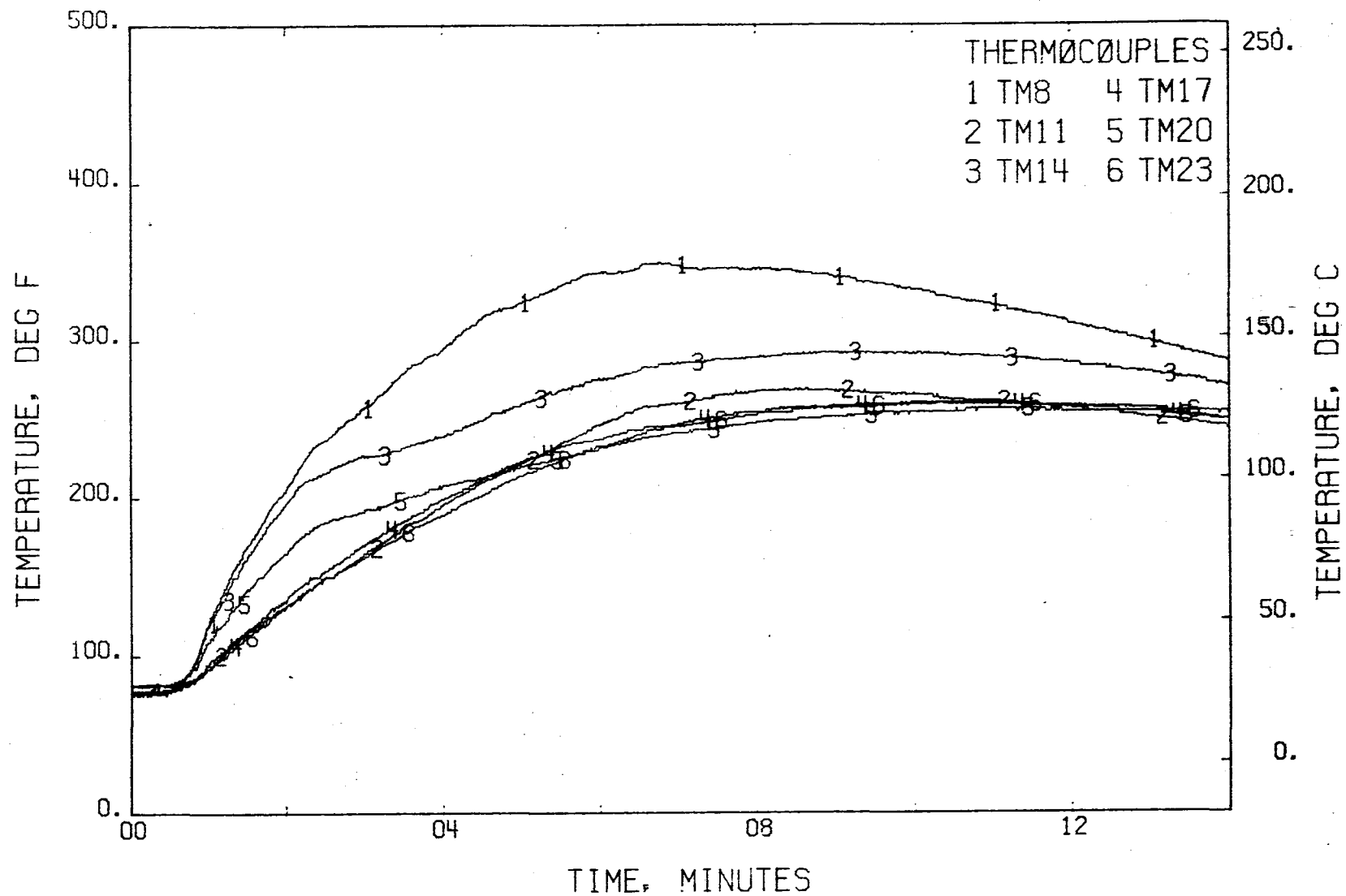


FIGURE 430 . - TEMPERATURES, STORAGE BINS  
TEST 20

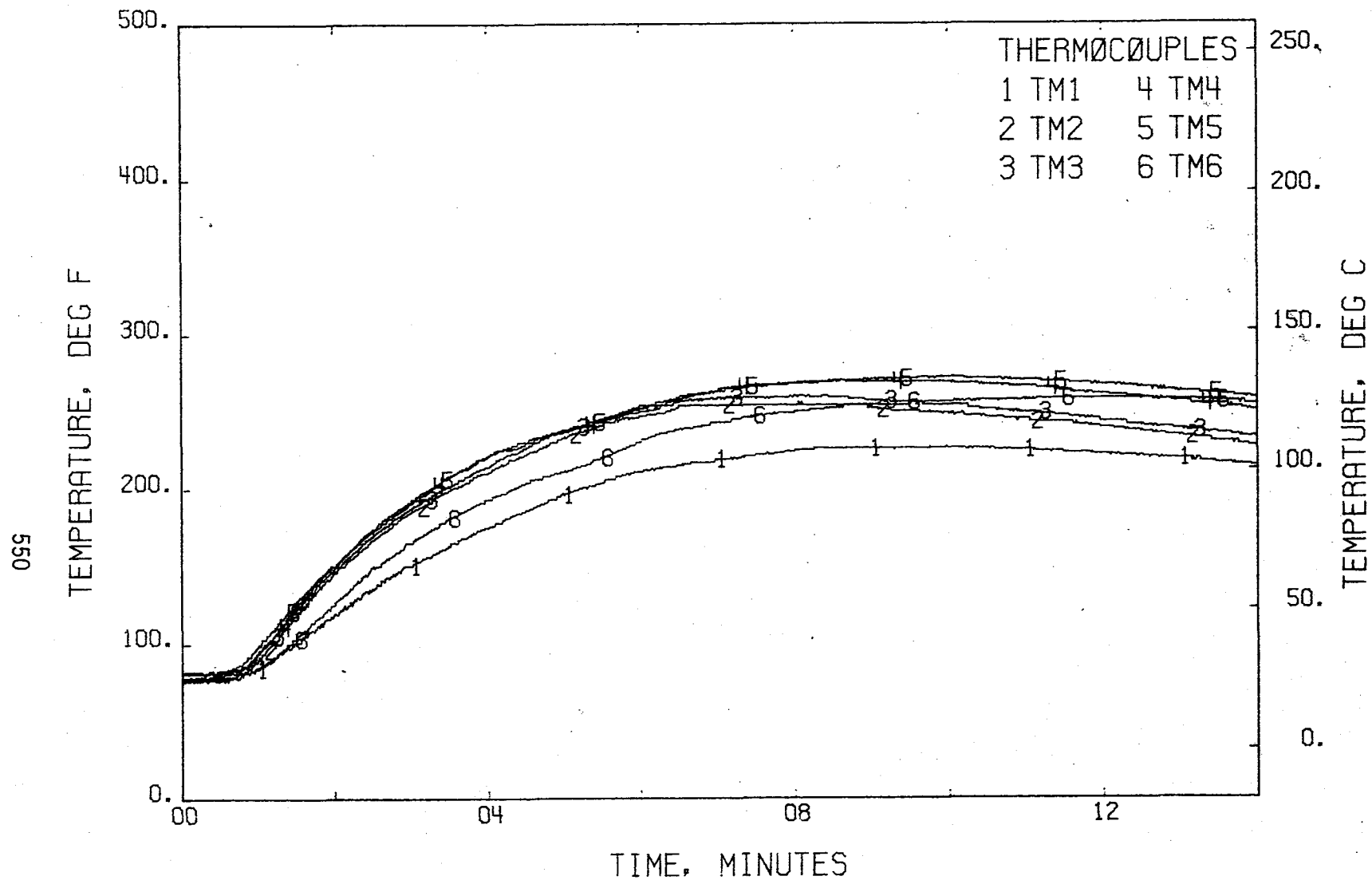


FIGURE 431 . - TEMPERATURES, CEILING PANELS (AFT)  
TEST 20

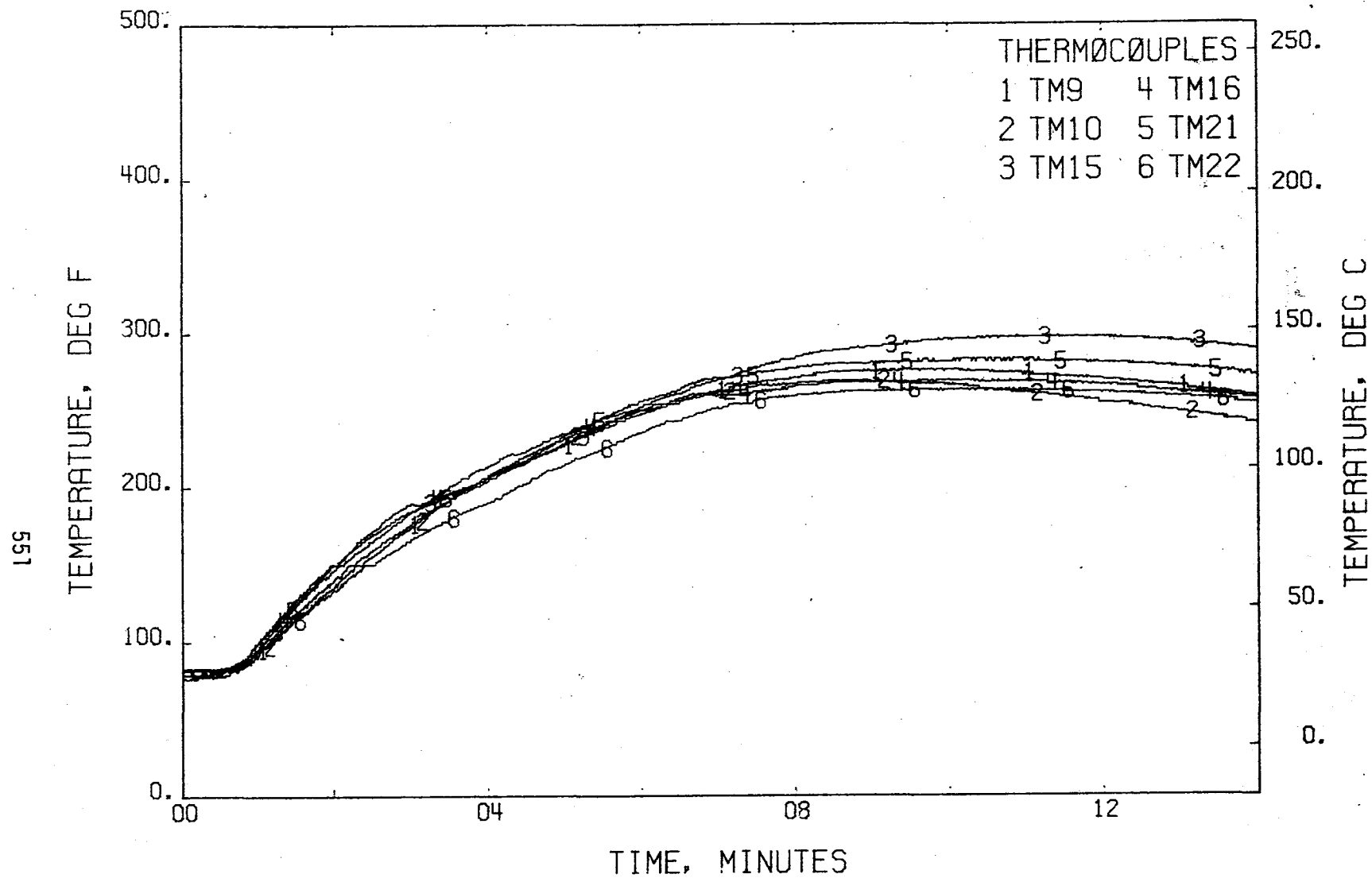


FIGURE 432 . - TEMPERATURES, CEILING PANEL (CENTER)  
TEST 20

552

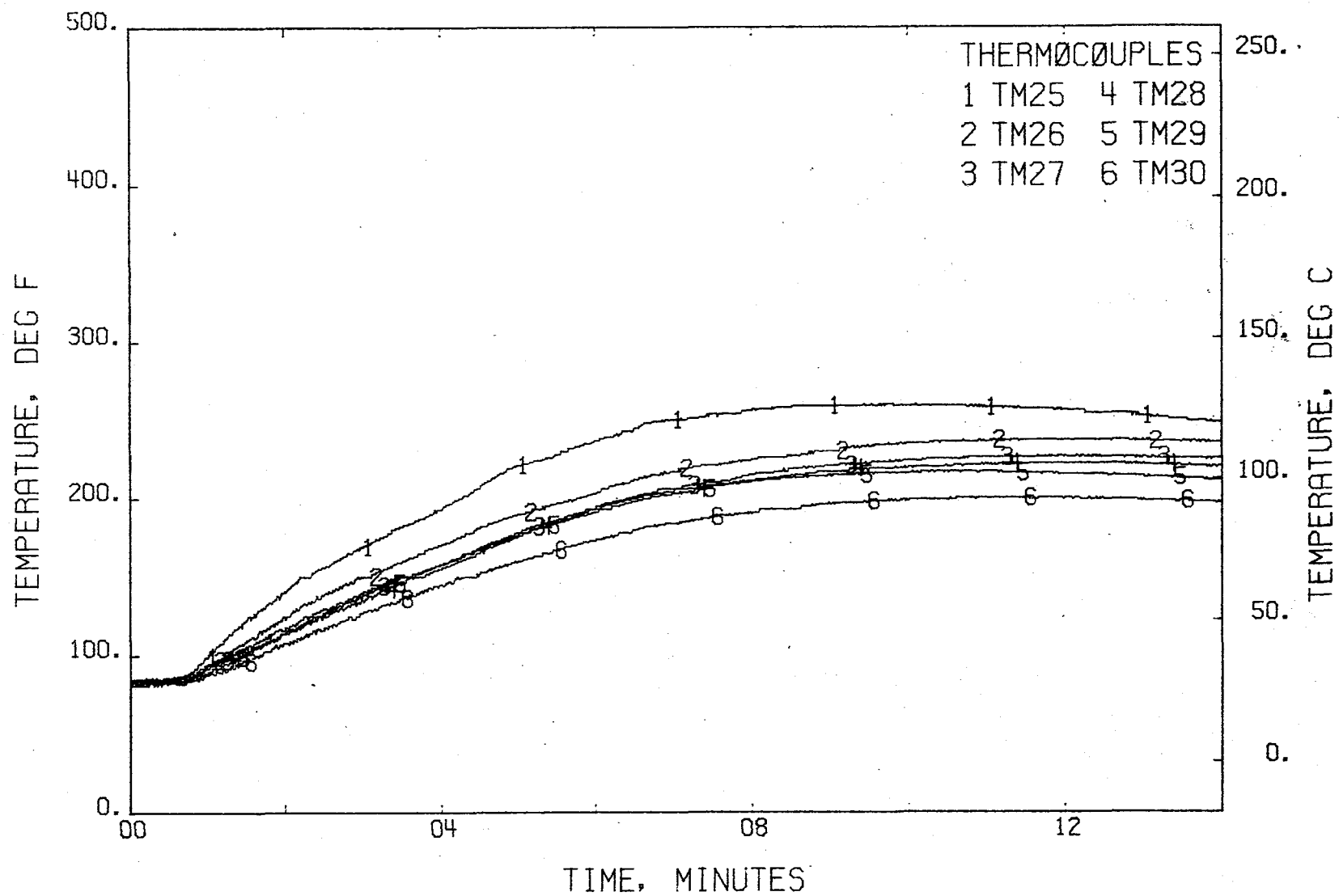


FIGURE 433 . - TEMPERATURES, CEILING PANELS (FORWARD)  
TEST 20



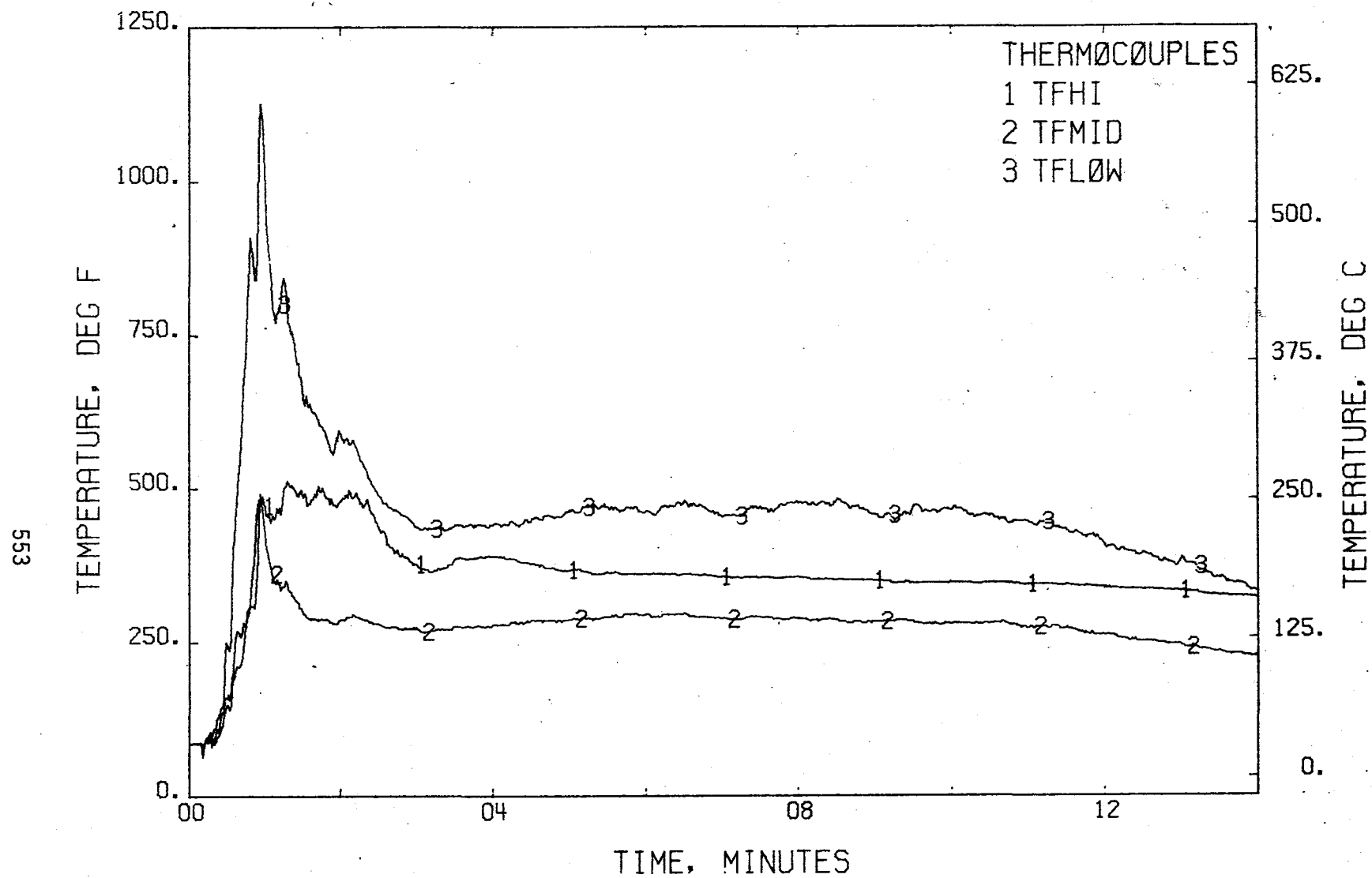


FIGURE 434 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 20

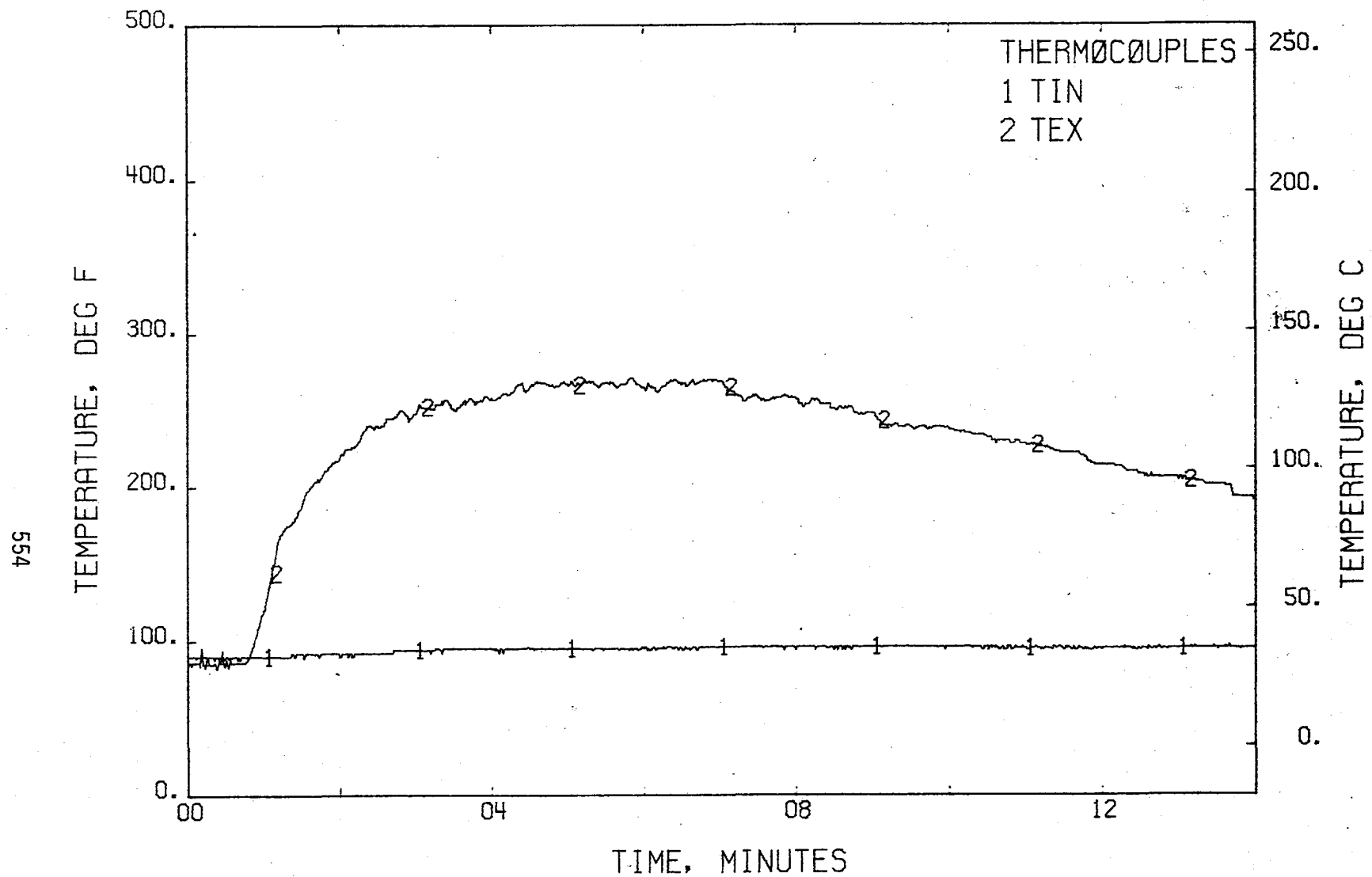


FIGURE 435 - TEMPERATURES, INLET + EXIT  
TEST 20

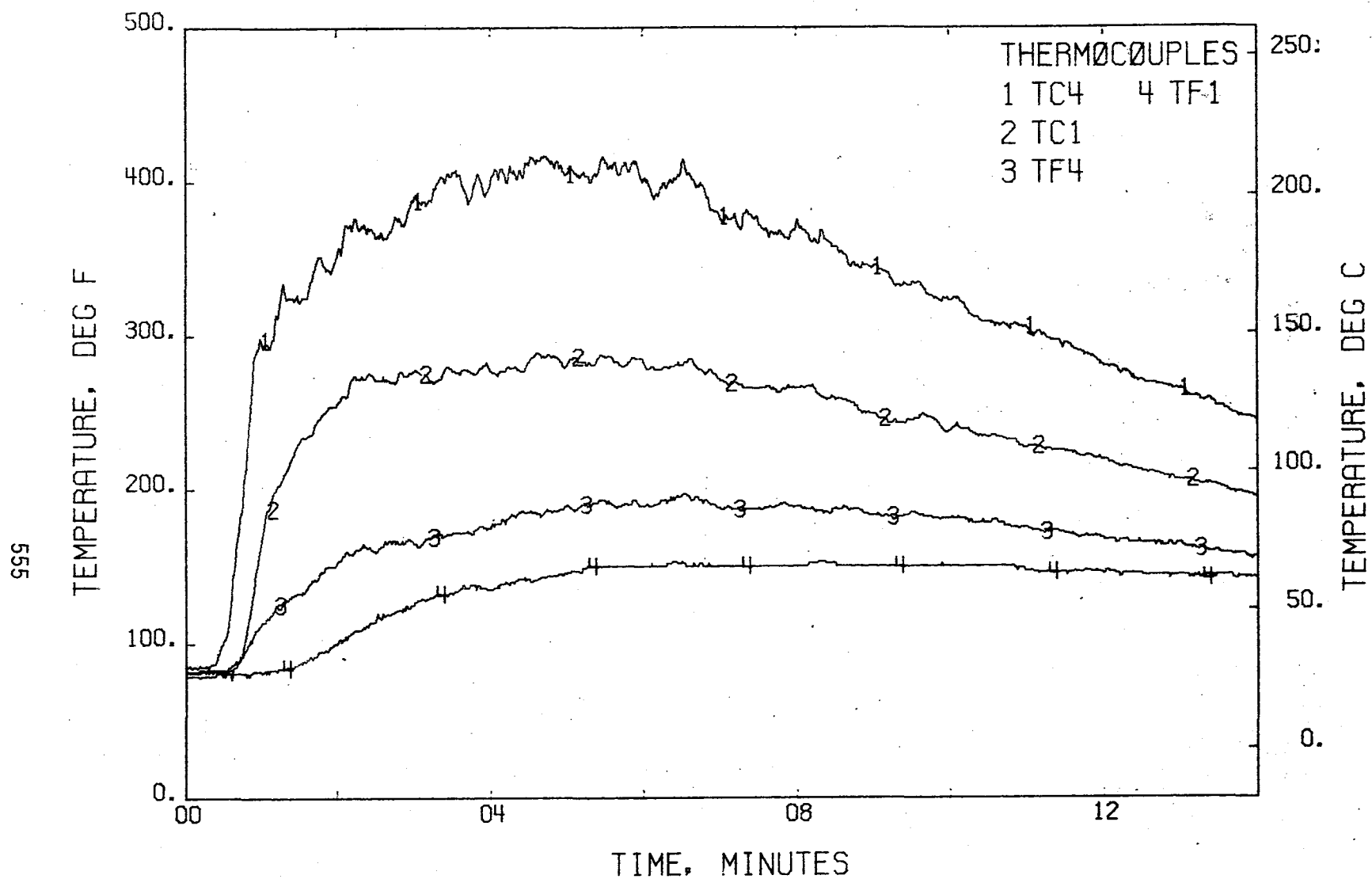


FIGURE 436 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 20

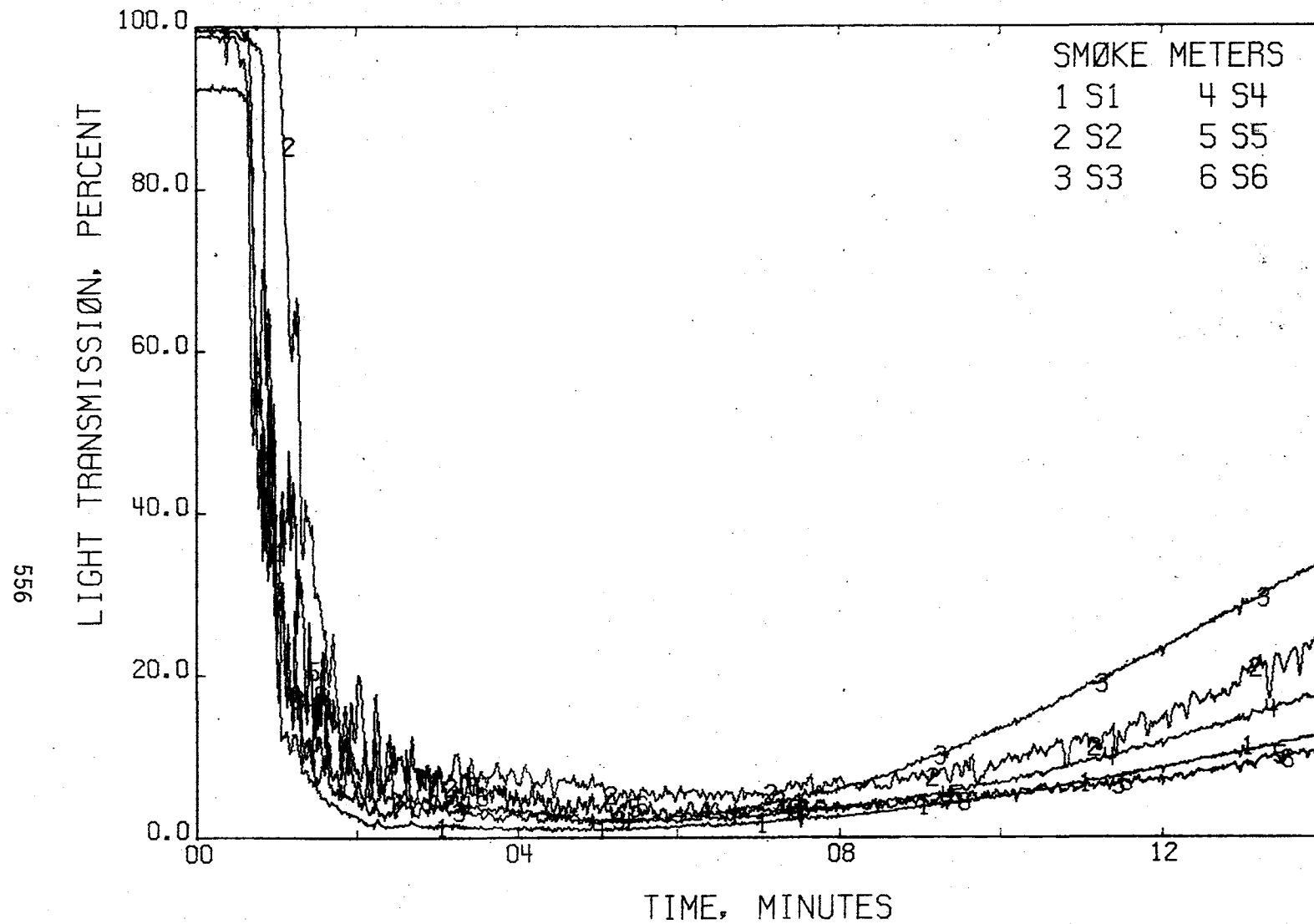


FIGURE 437 . - LIGHT TRANSMISSION  
TEST 20

557

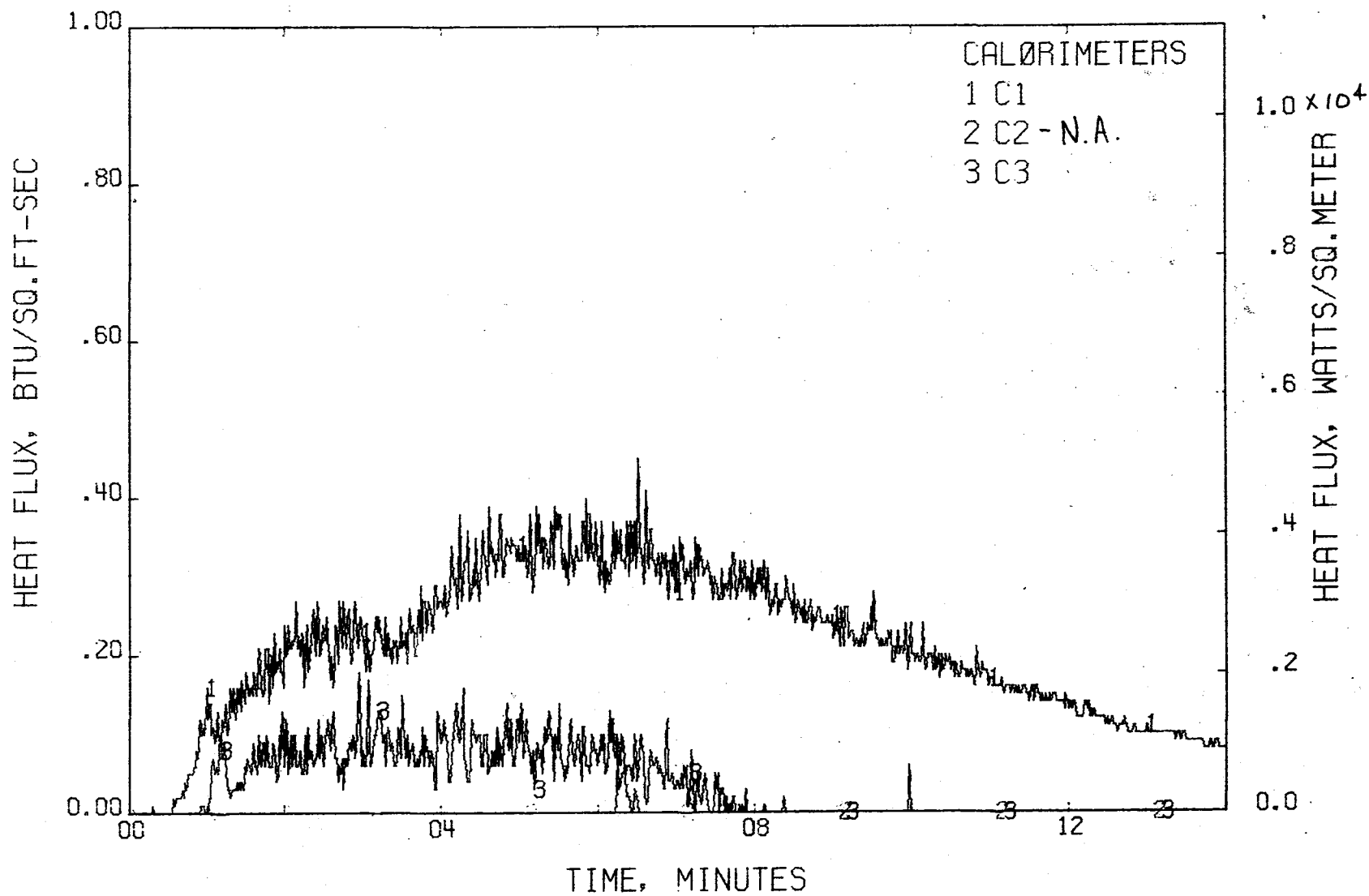


FIGURE 438 . - HEAT FLUX, AFT  
TEST 20

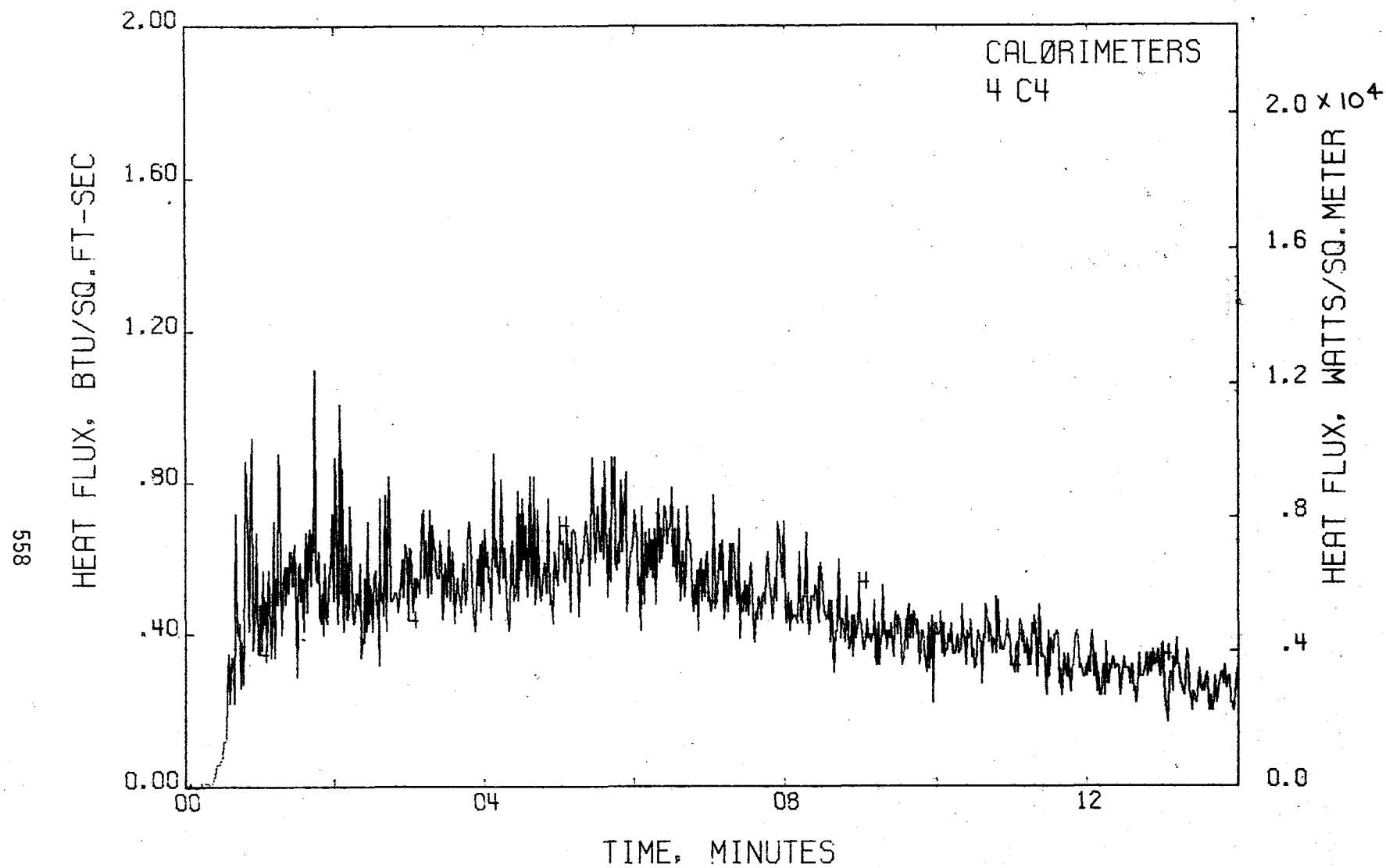


FIGURE 439 . - HEAT FLUX, MIDSECTION  
TEST 20

559

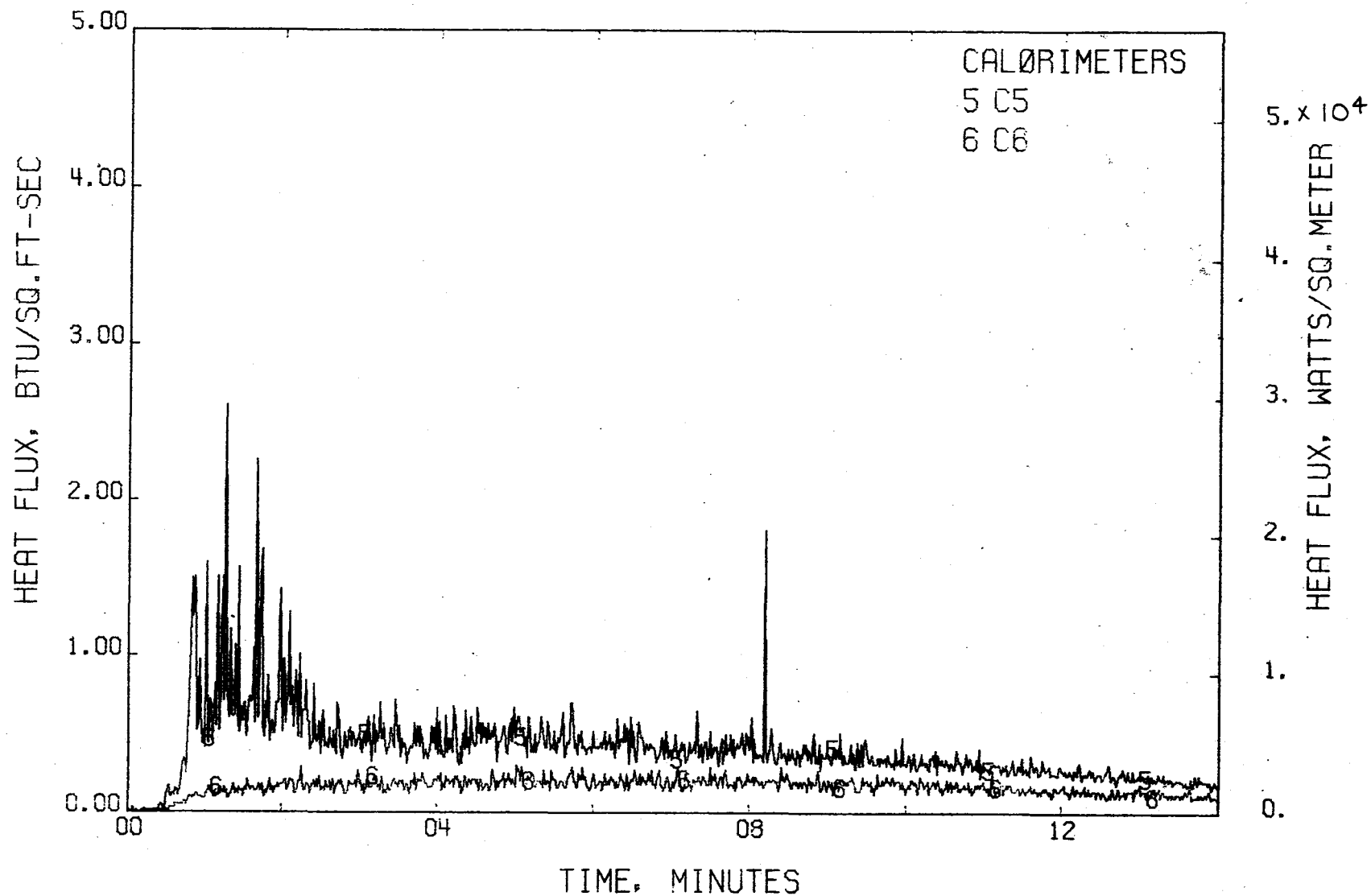


FIGURE 439 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 20

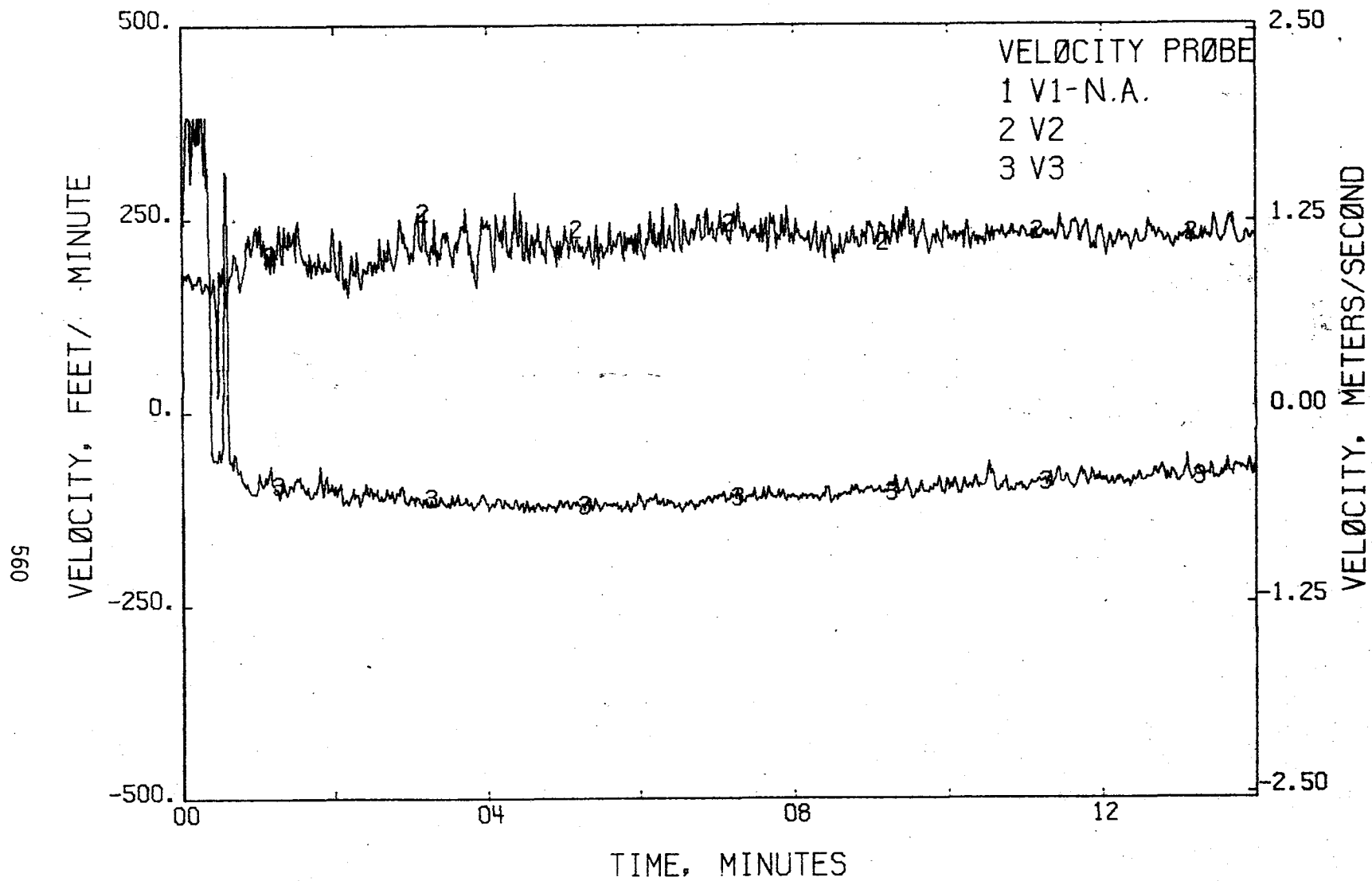


FIGURE 440 . - AIR VELOCITY  
TEST 20



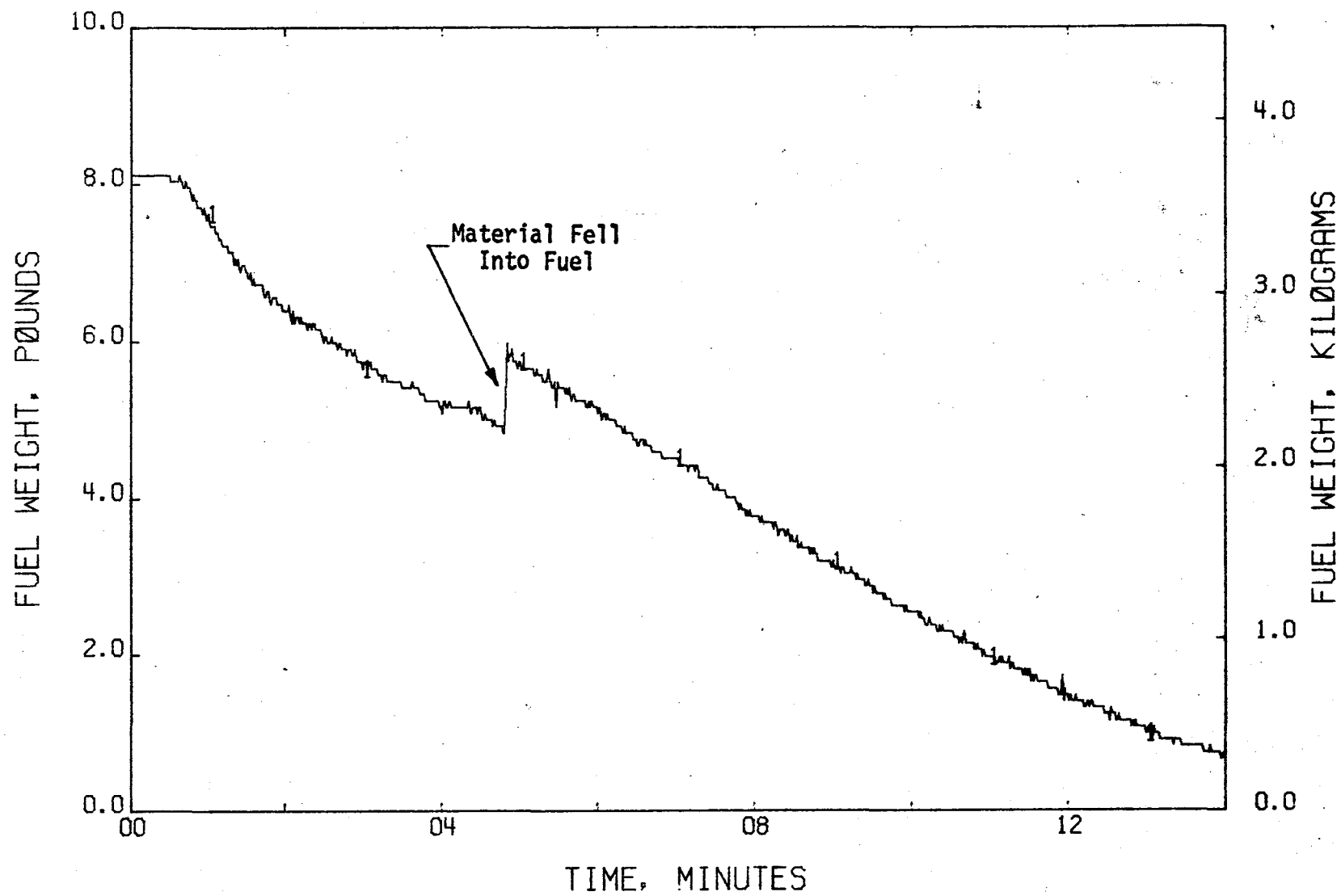


FIGURE 441 . - FUEL WEIGHT LOSS  
TEST 20

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 3 PPM

HYDROGEN FLUORIDE - < 3 PPM

HYDROGEN CHLORIDE - < 6 PPM

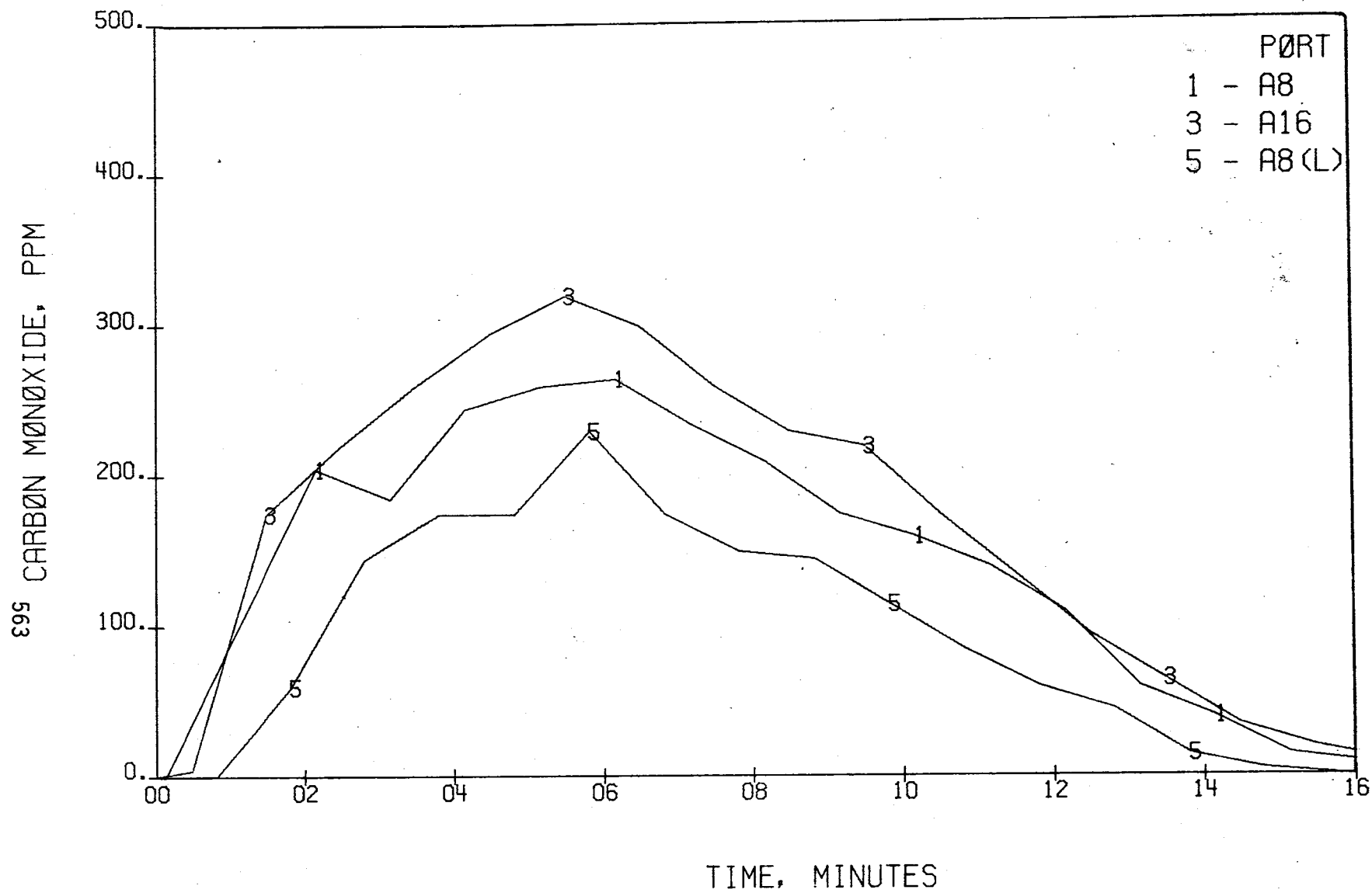


FIGURE 443. - CARBON MONOXIDE CONCENTRATIONS, AFT TEST 20

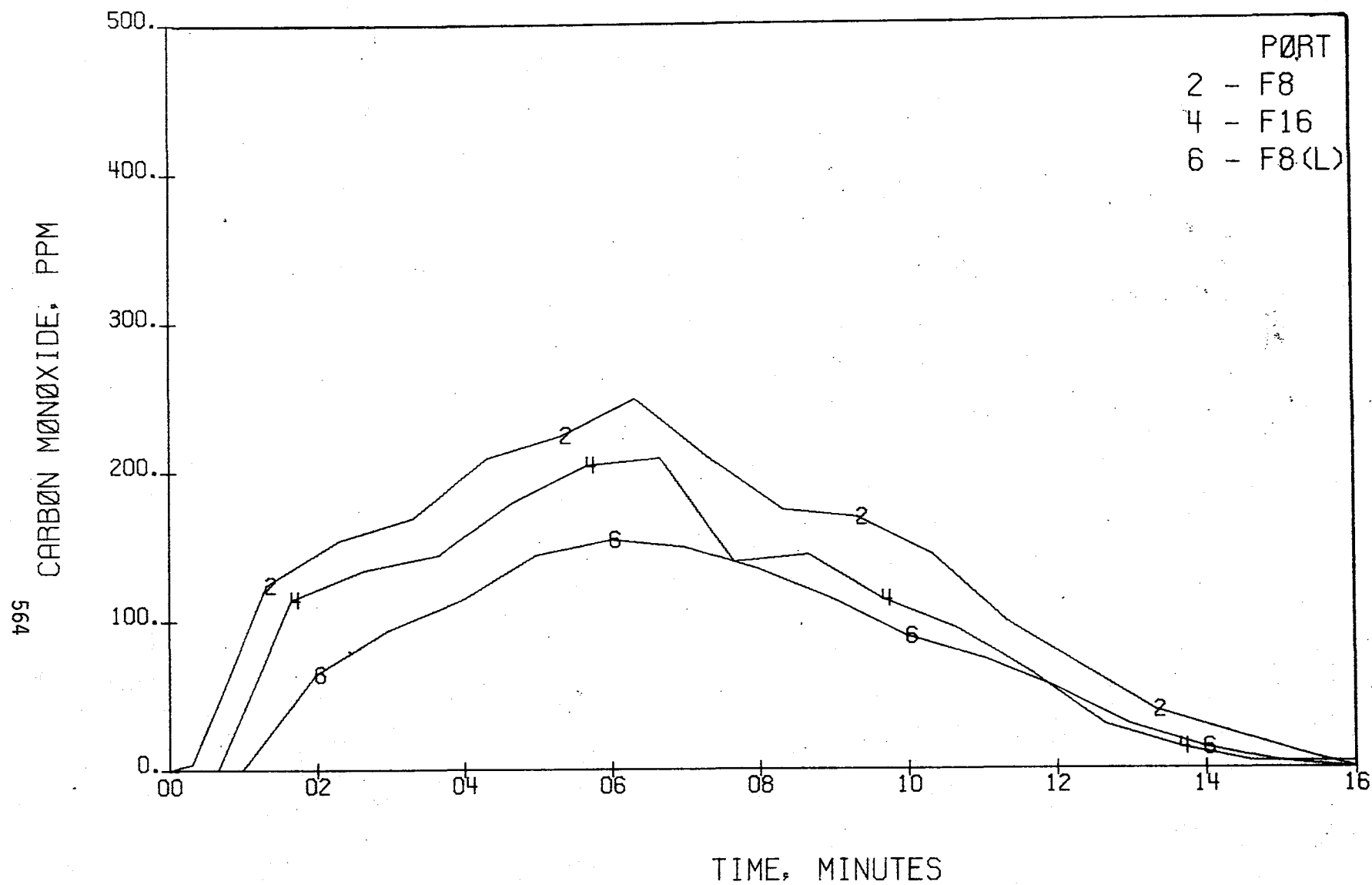


FIGURE 444 - CARBON MONOXIDE CONCENTRATIONS, FØRE TEST 20

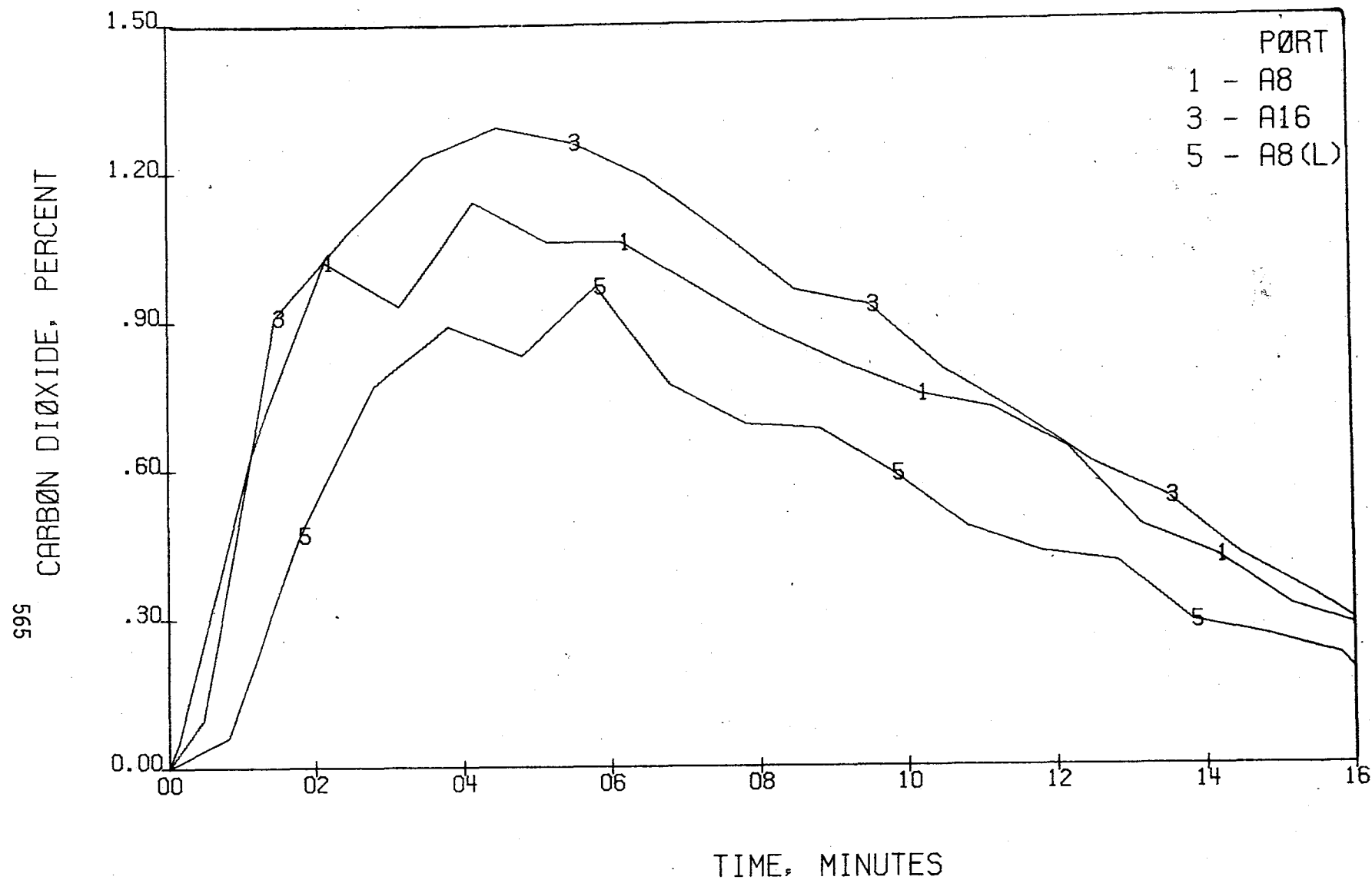


FIGURE 445 . - CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 20

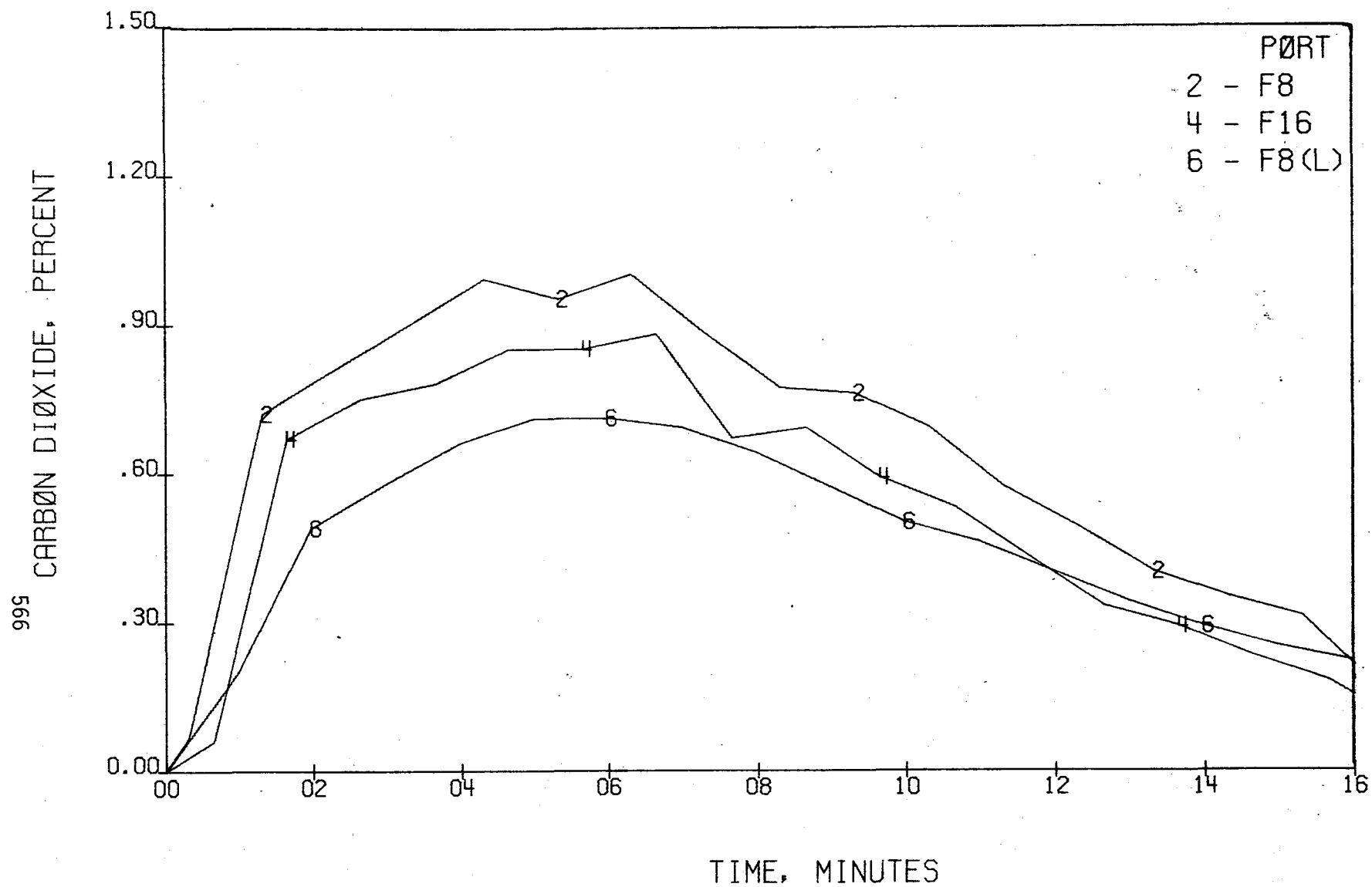


FIGURE 446 . - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 20

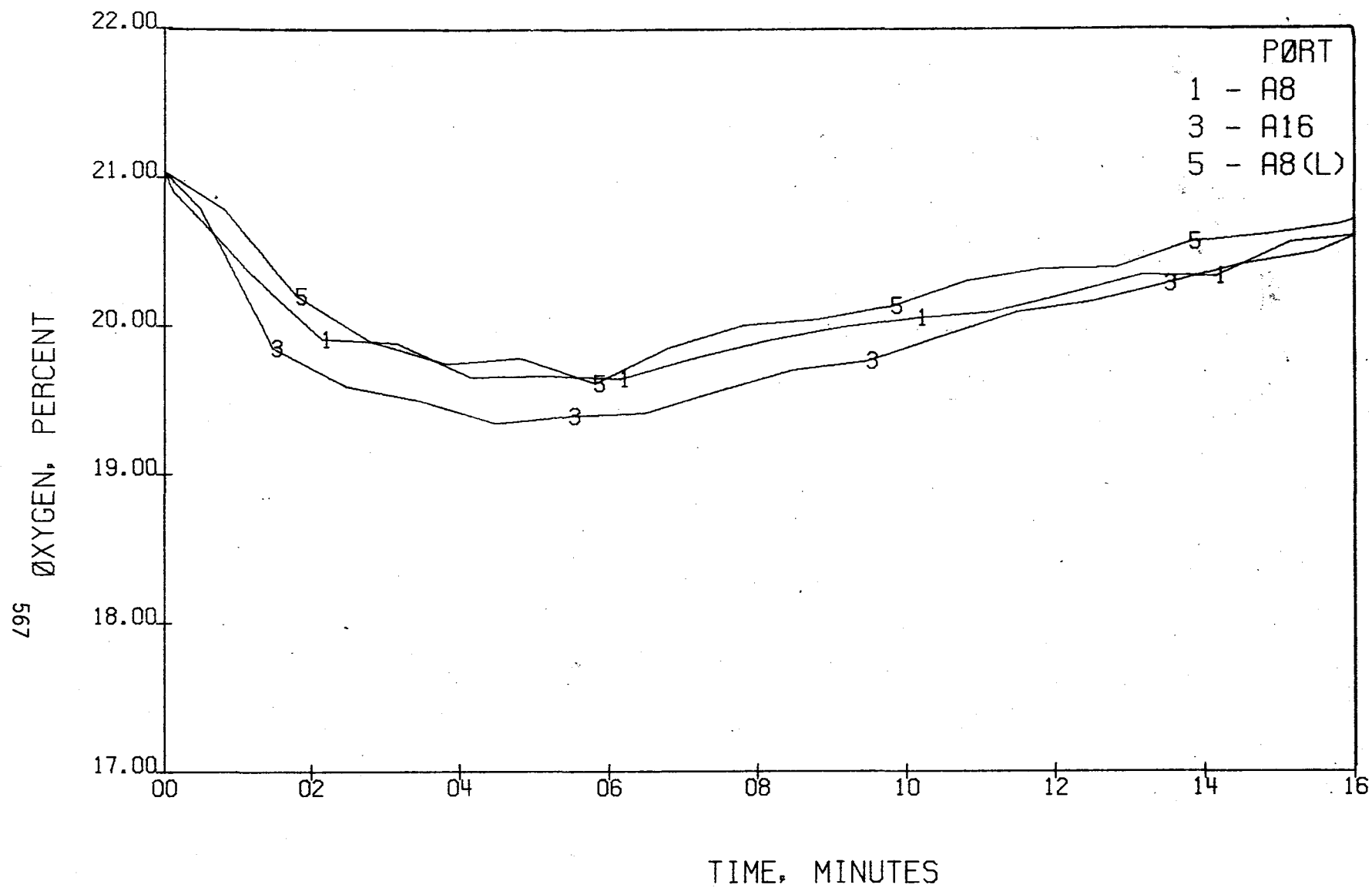


FIGURE 447 - ØXYGEN CØNCENTRATIONS, AFT TEST 20

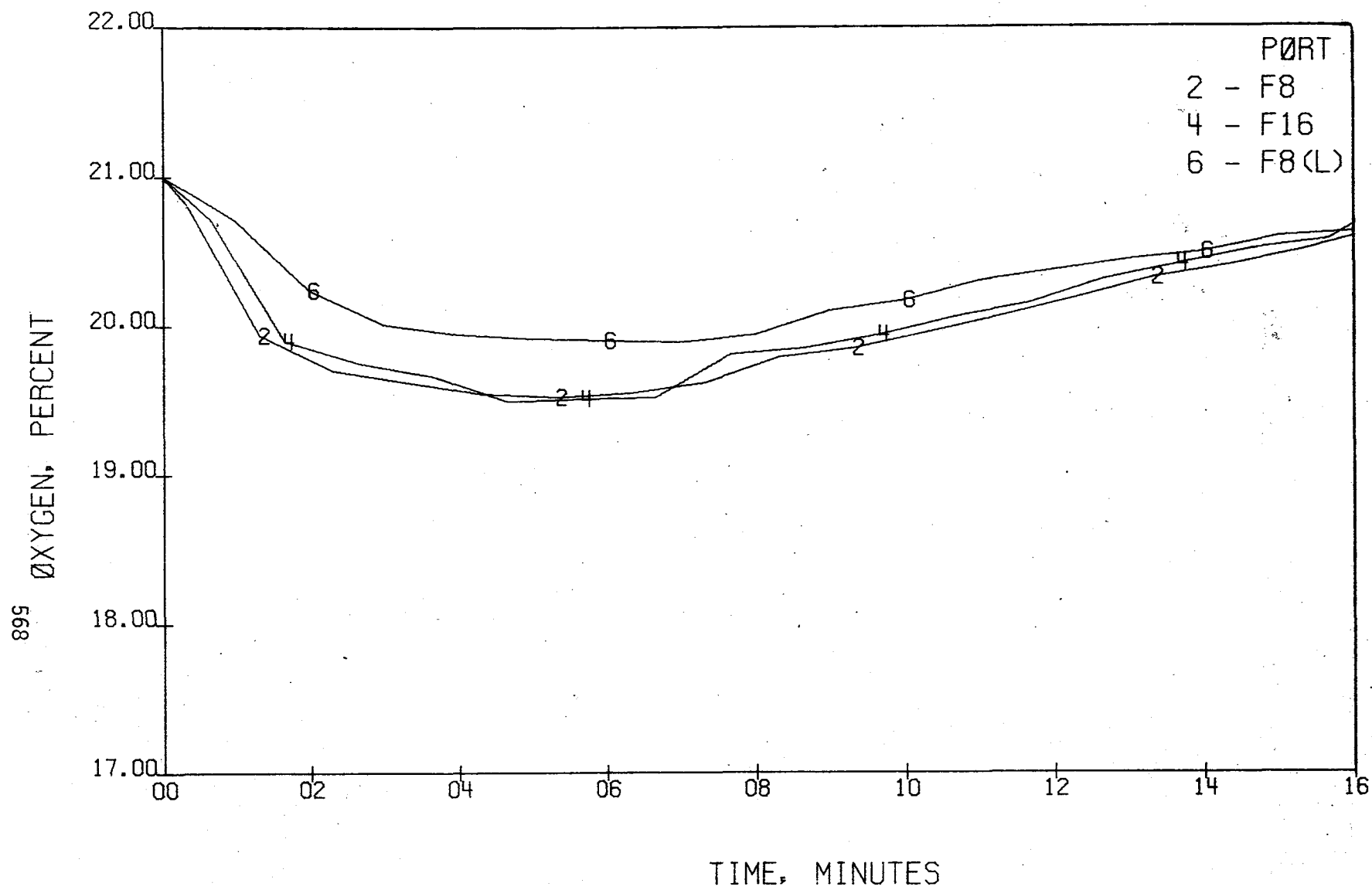


FIGURE 448 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 20



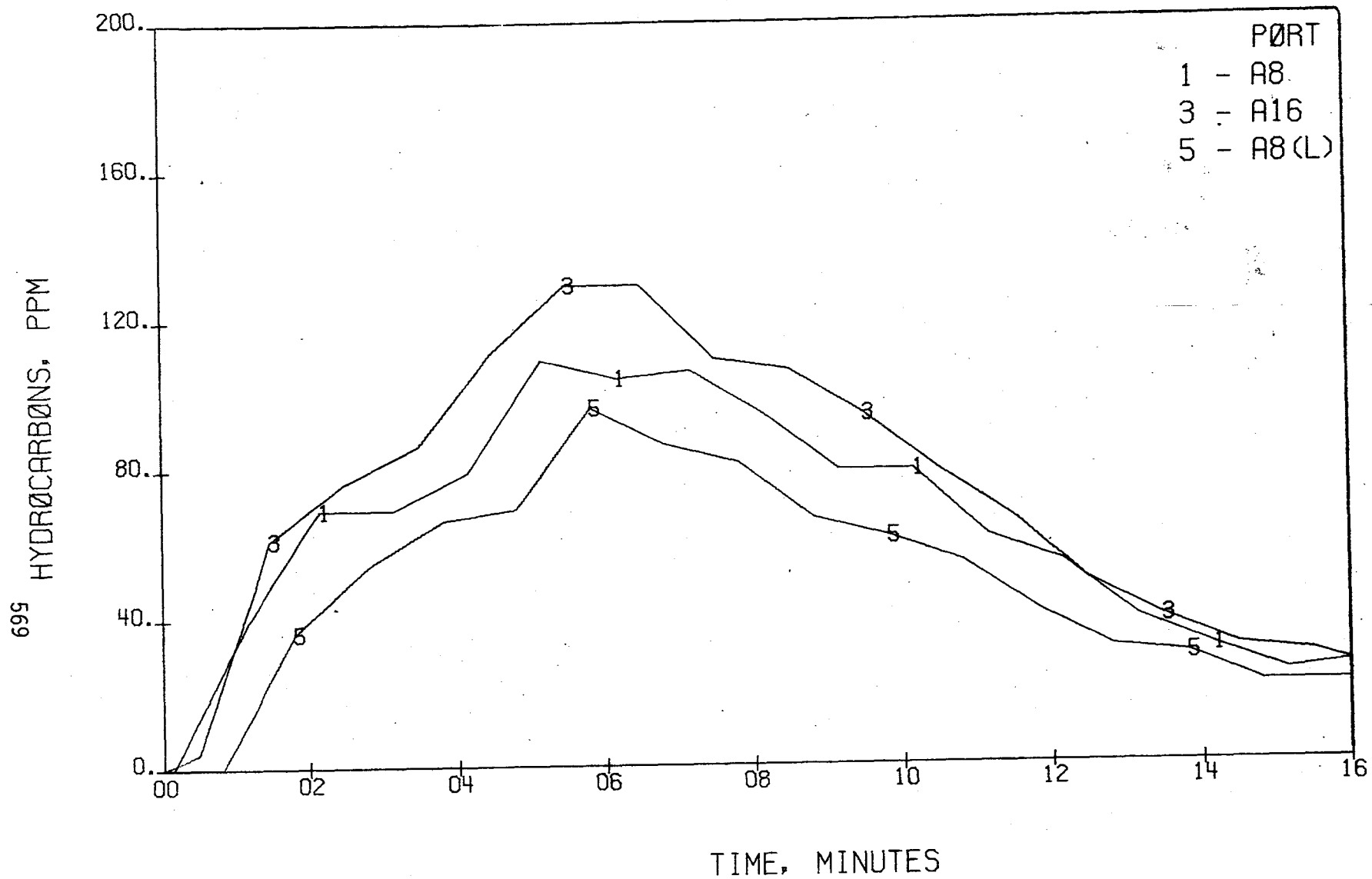


FIGURE 449. - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 20

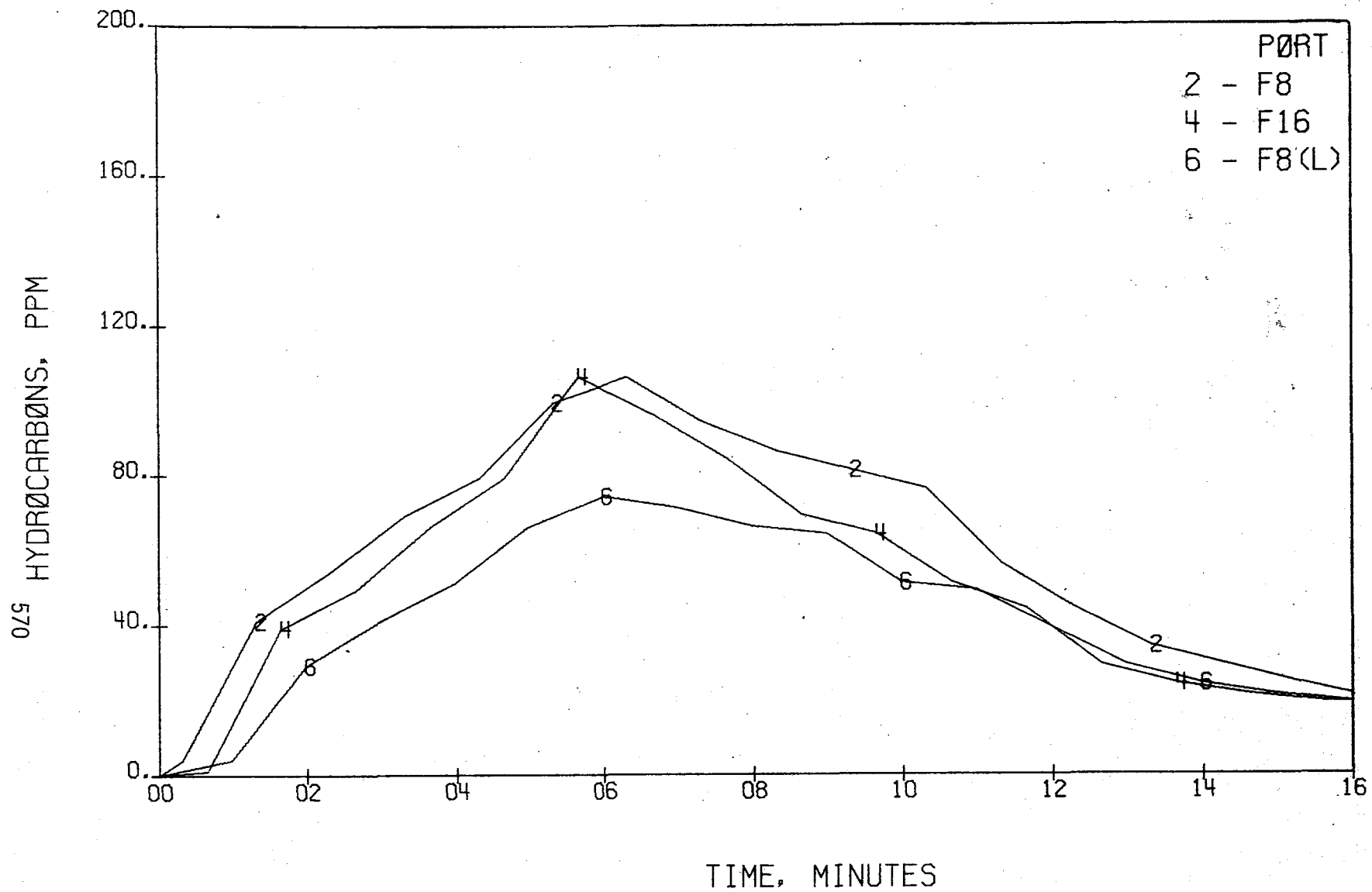


FIGURE 450 - HYDROCARBONS CONCENTRATIONS, FØRE TEST 20

TEST 21

---

PSU, BIN, AND CEILING PANELS

NO PRE-TEST PHOTO WAS TAKEN FOR TEST 21

TEST 21

PSU, BIN, AND CEILING PANELS



FIGURE 451. - POST-TEST CONFIGURATION, TEST 21



FIGURE 452 . - FIRE DURING TEST 21

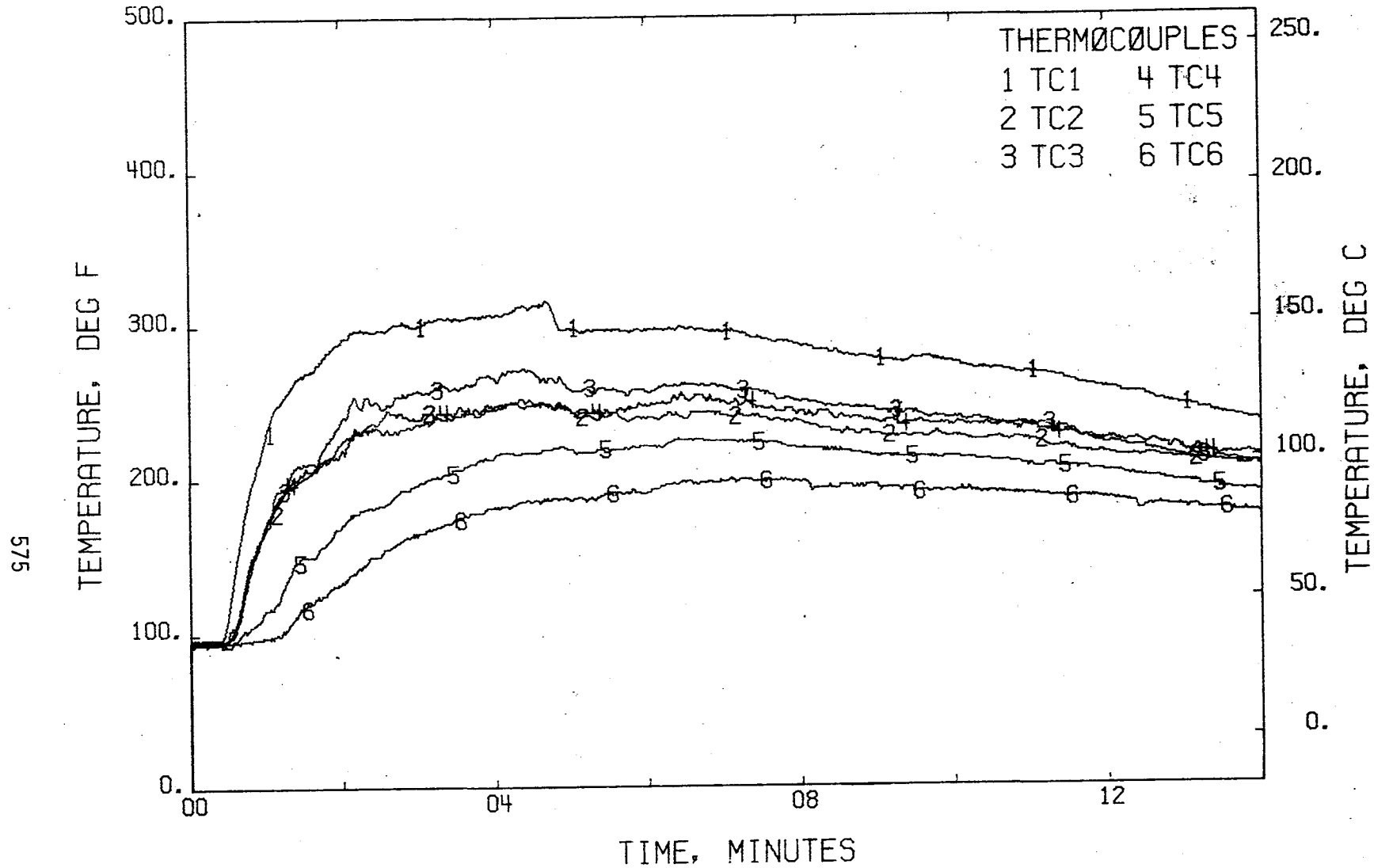


FIGURE 453 . - TEMPERATURES, T/C TREE 1  
TEST 21

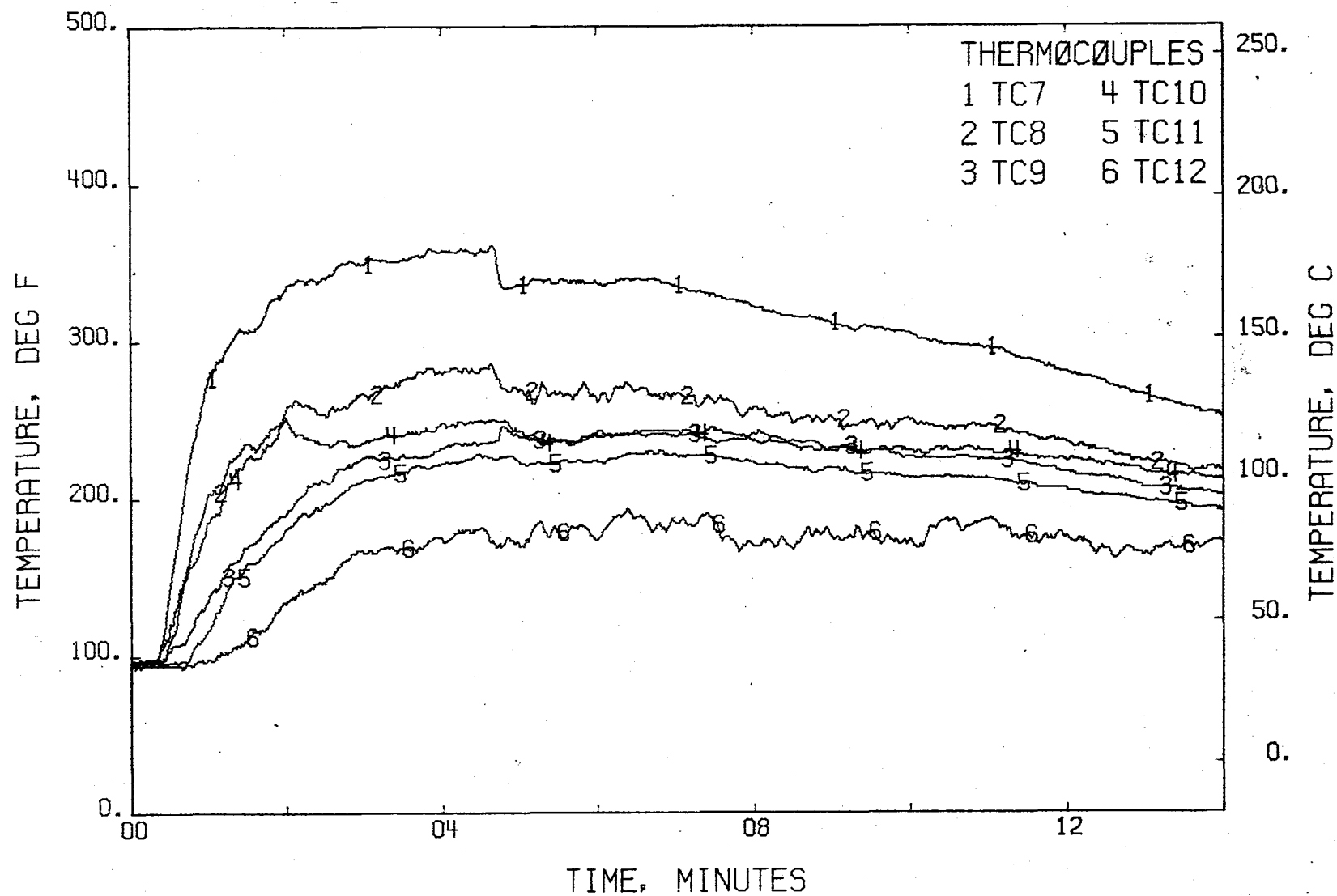


FIGURE 454 . - TEMPERATURES, T/C TREE 2  
TEST 21



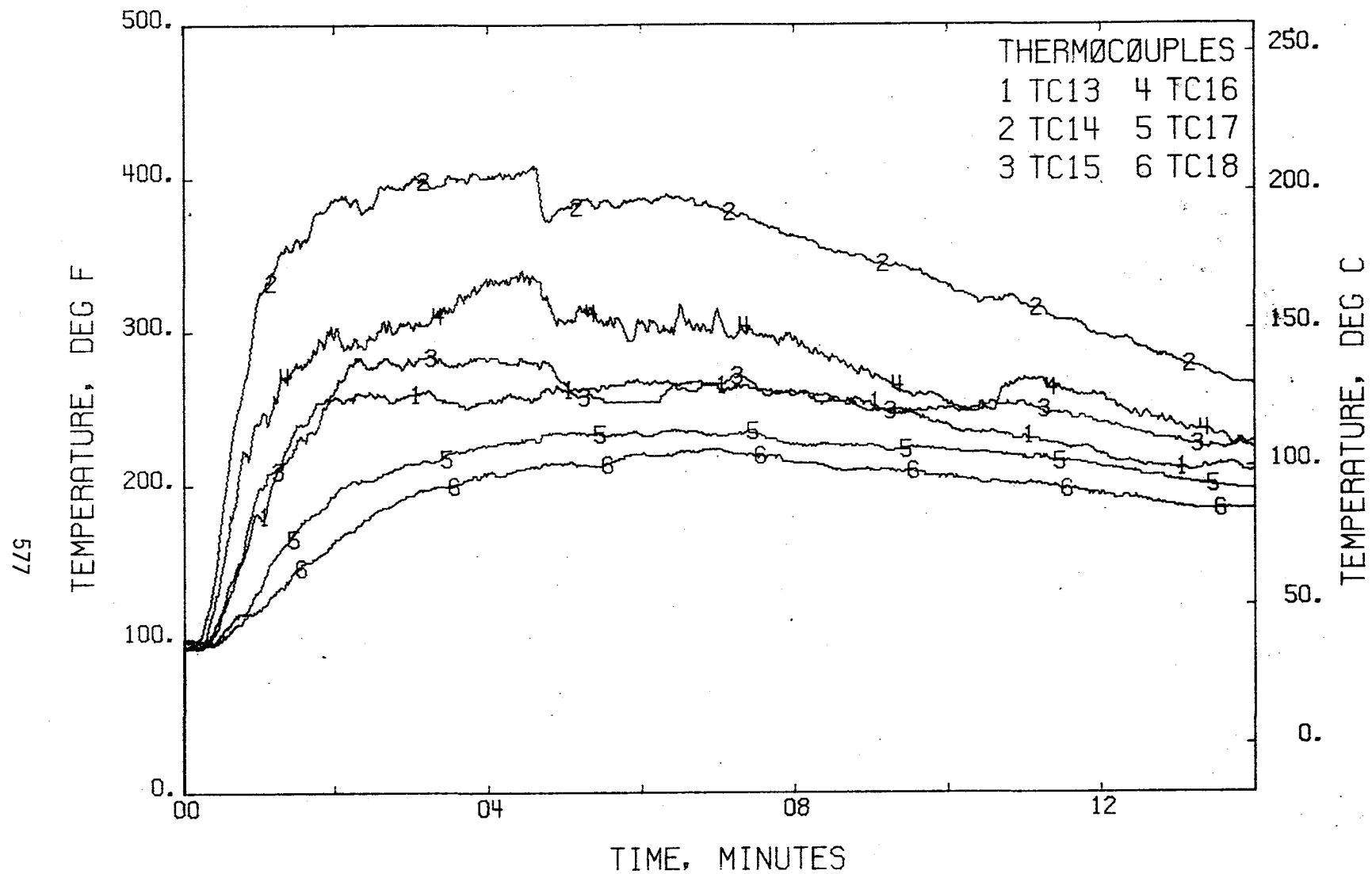


FIGURE 455 . - TEMPERATURES, T/C TREE 3  
TEST 21

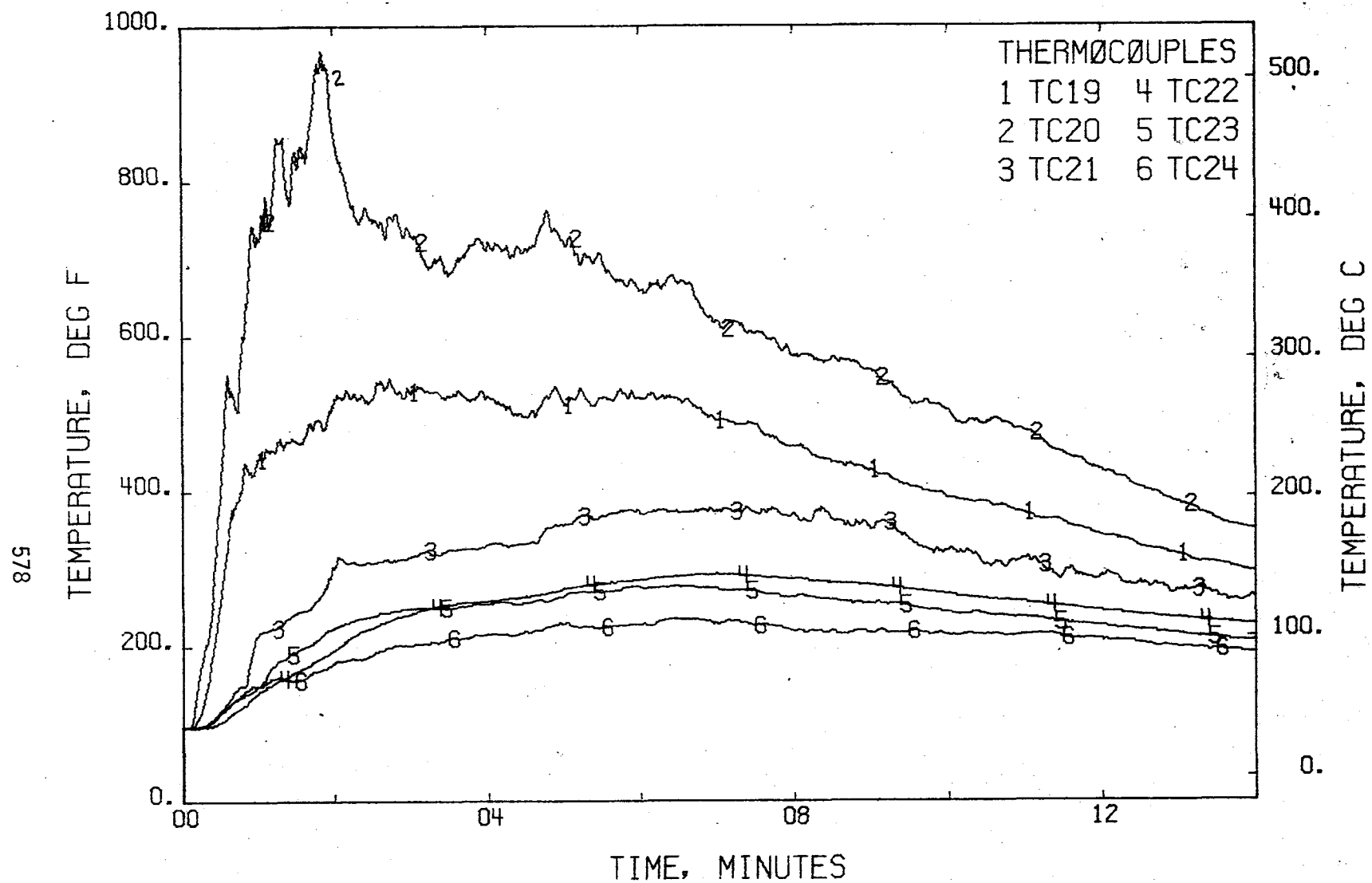


FIGURE 456 . - TEMPERATURES, T/C TREE 4  
TEST 21

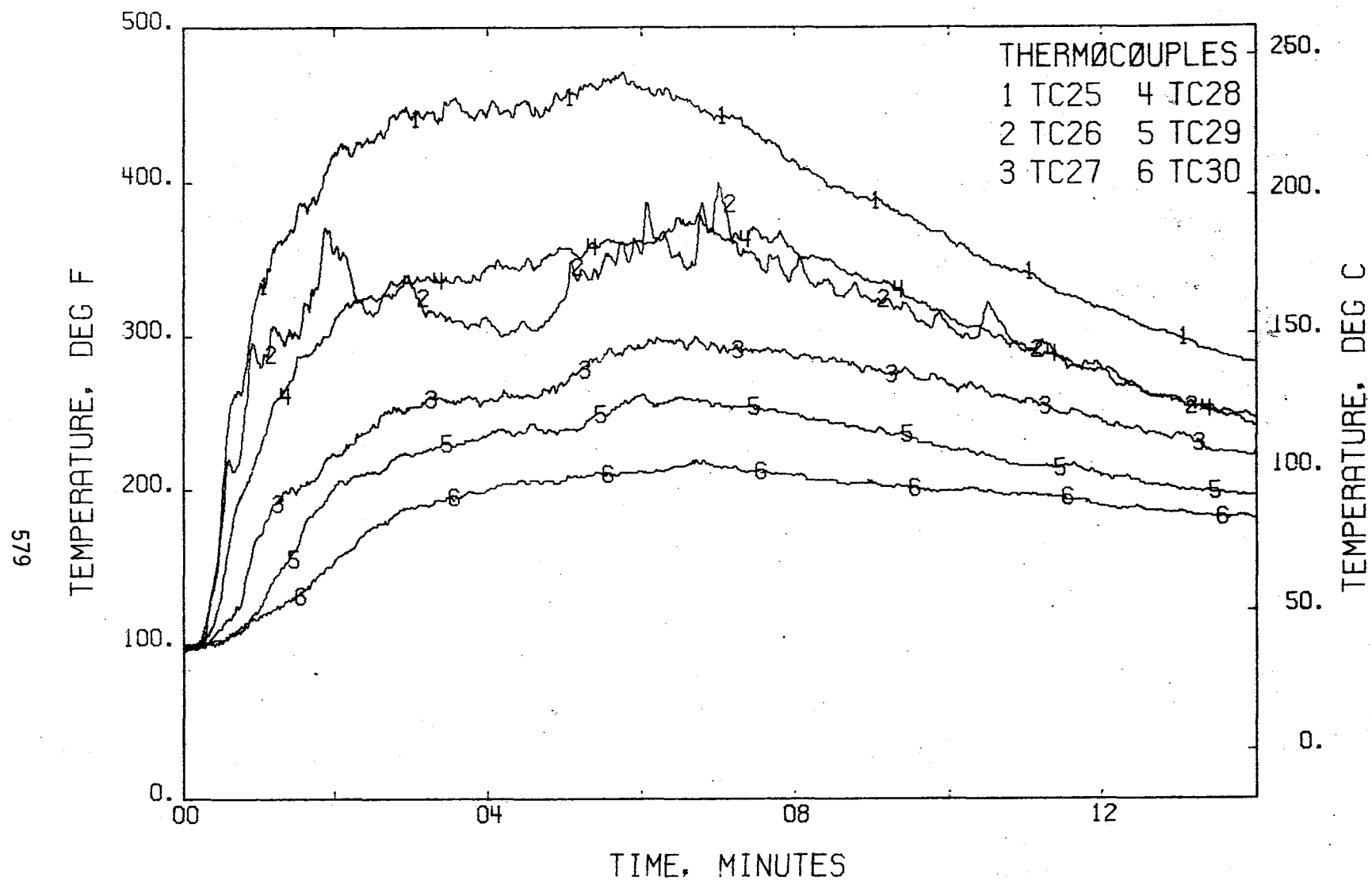


FIGURE 457 . - TEMPERATURES, T/C TREE 5  
TEST 21

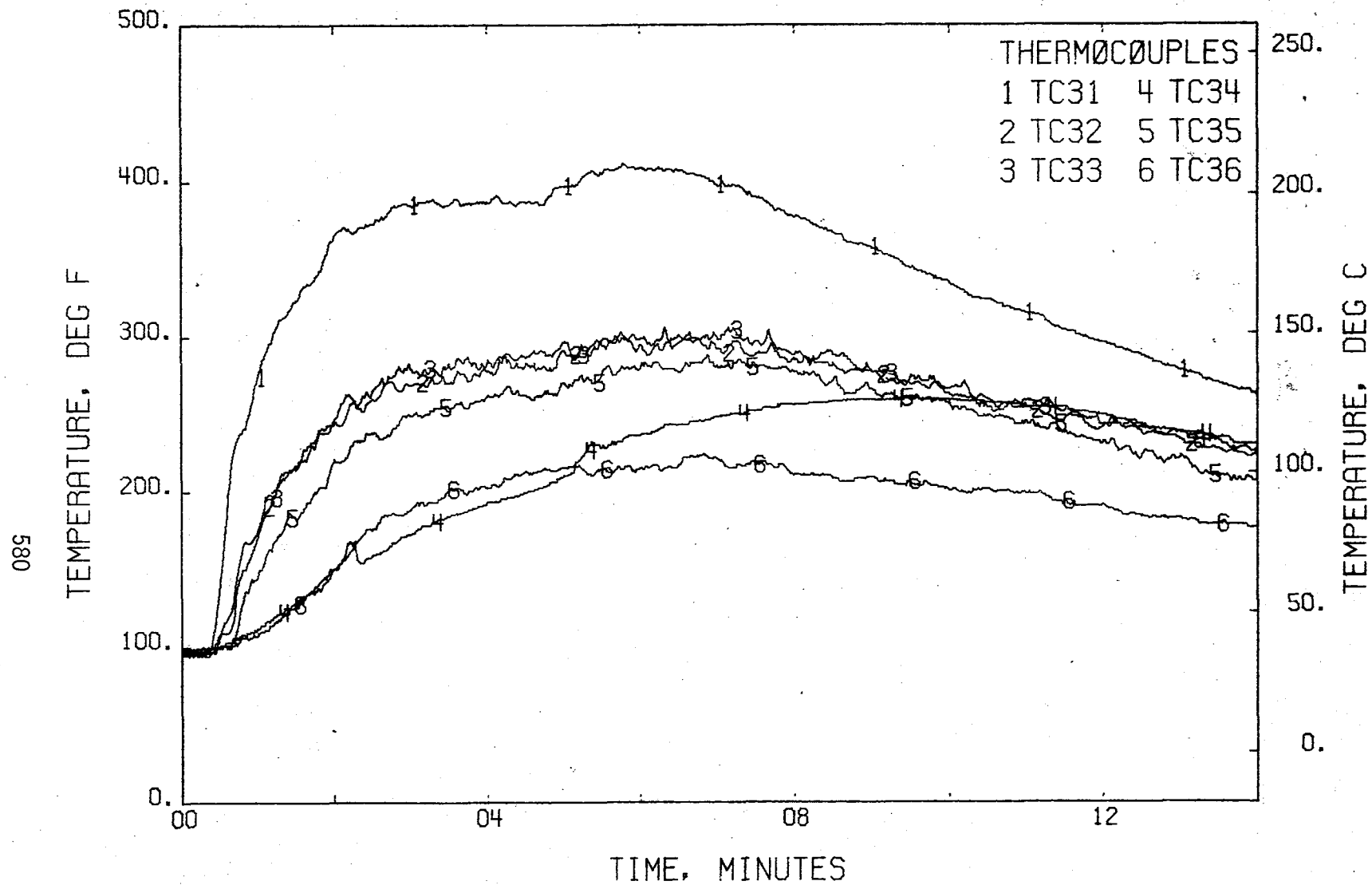


FIGURE 458 . - TEMPERATURES, T/C TREE 6  
TEST 21

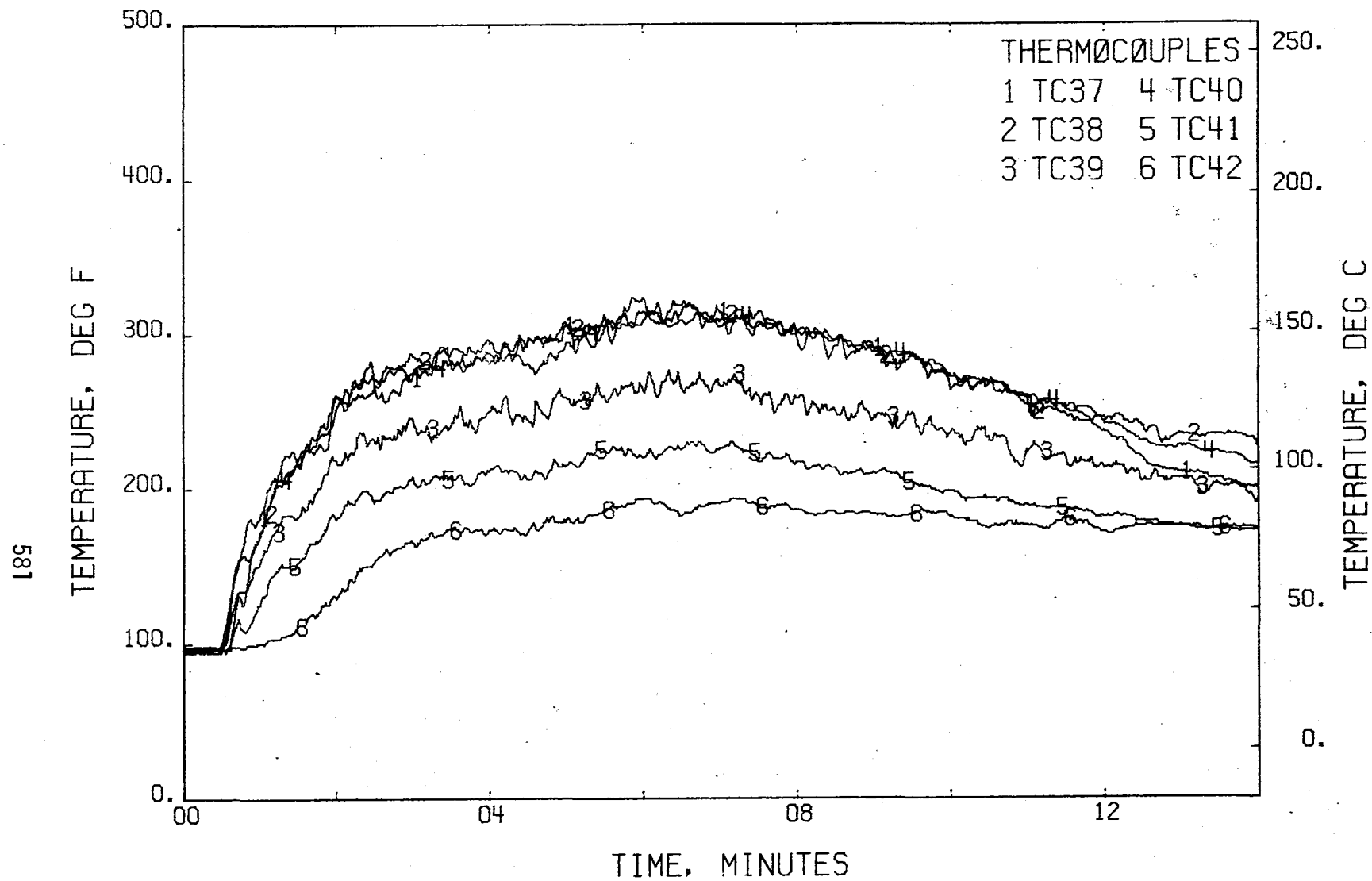


FIGURE 459 . - TEMPERATURES, T/C TREE 7  
TEST 21

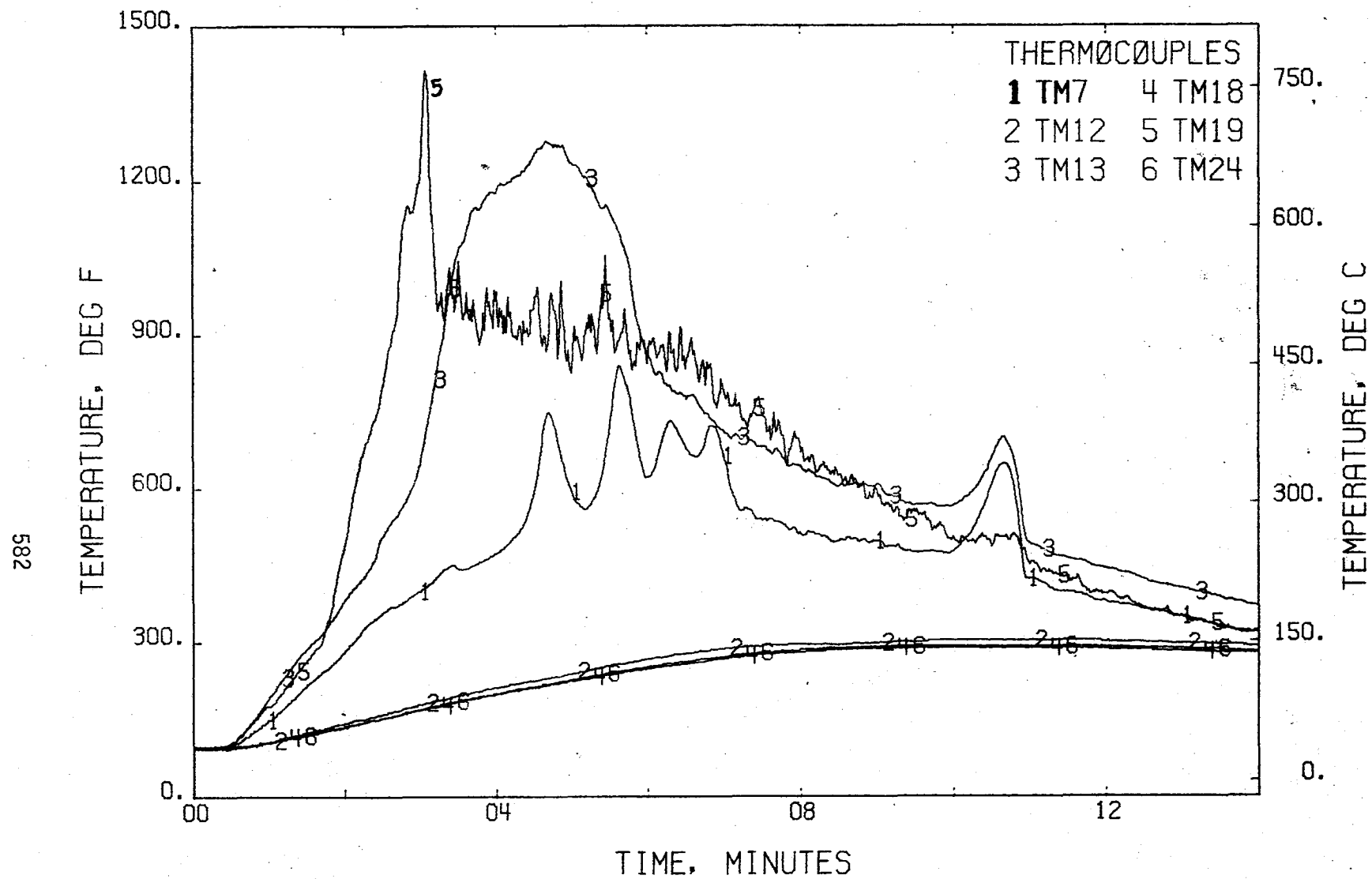


FIGURE 460 . - TEMPERATURES, PSU  
TEST 21

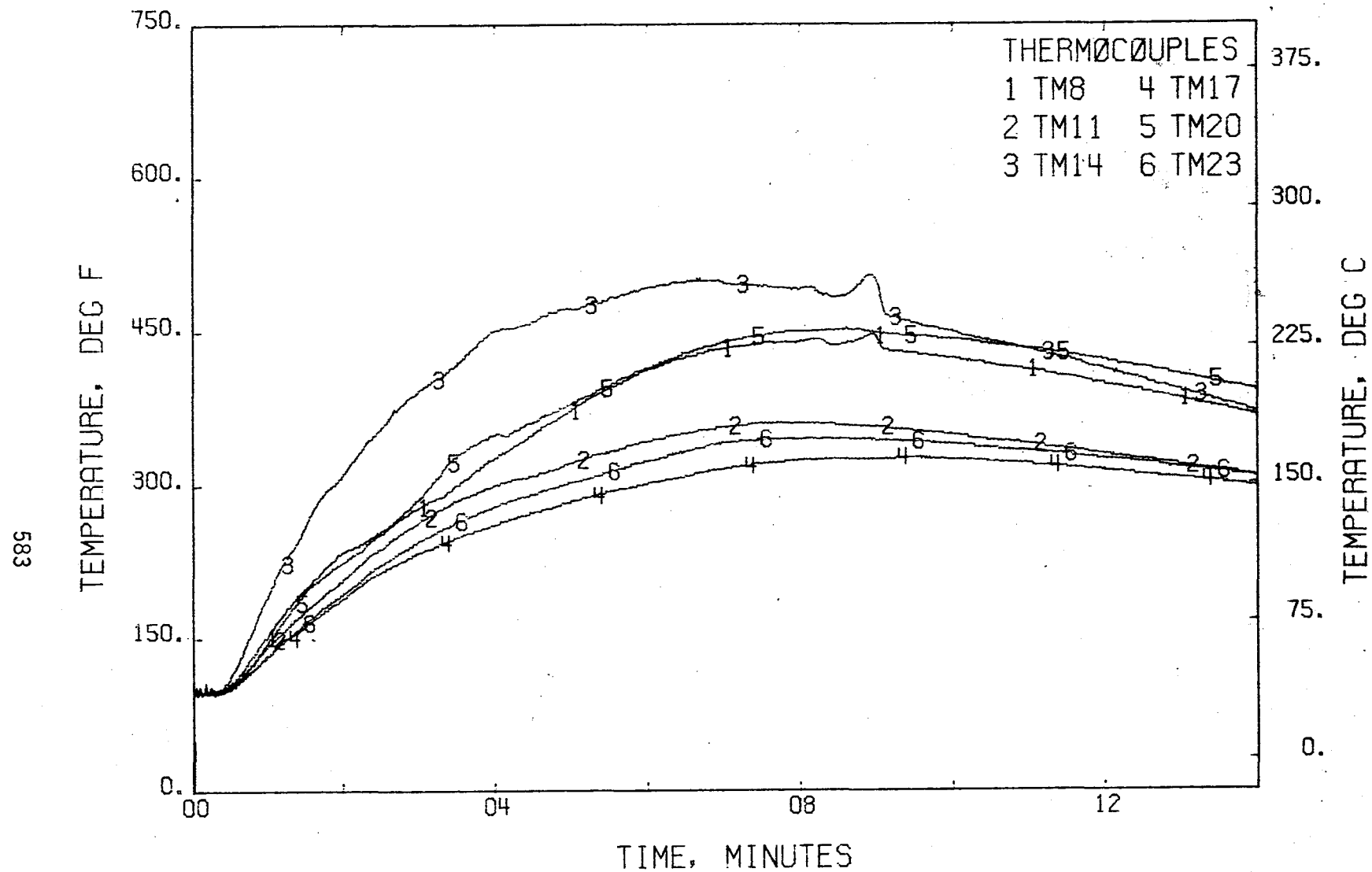


FIGURE 461 . - TEMPERATURES, STORAGE BINS  
TEST 21

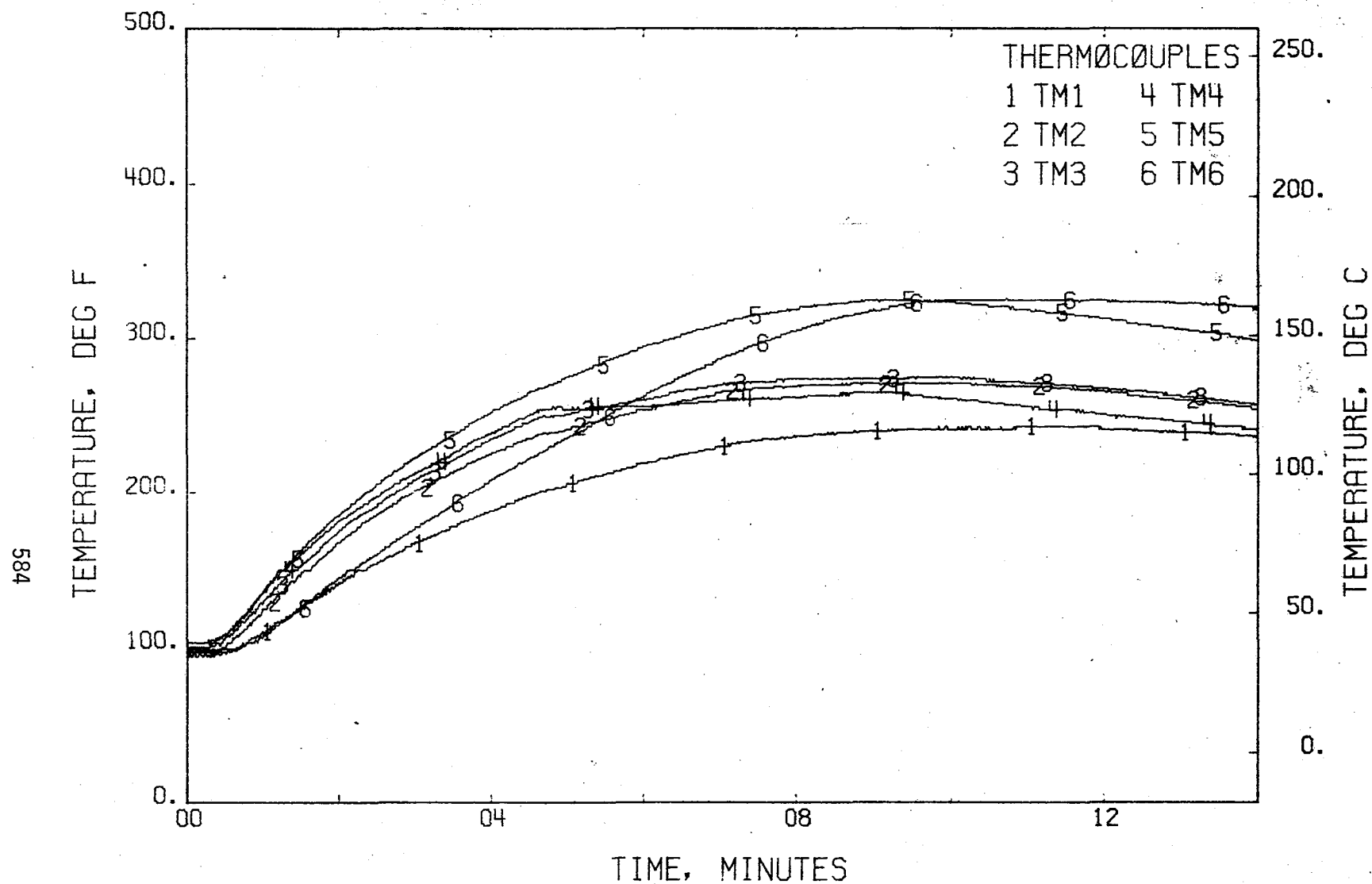


FIGURE 462 . - TEMPERATURES, CEILING PANELS (AFT)  
TEST 21



585

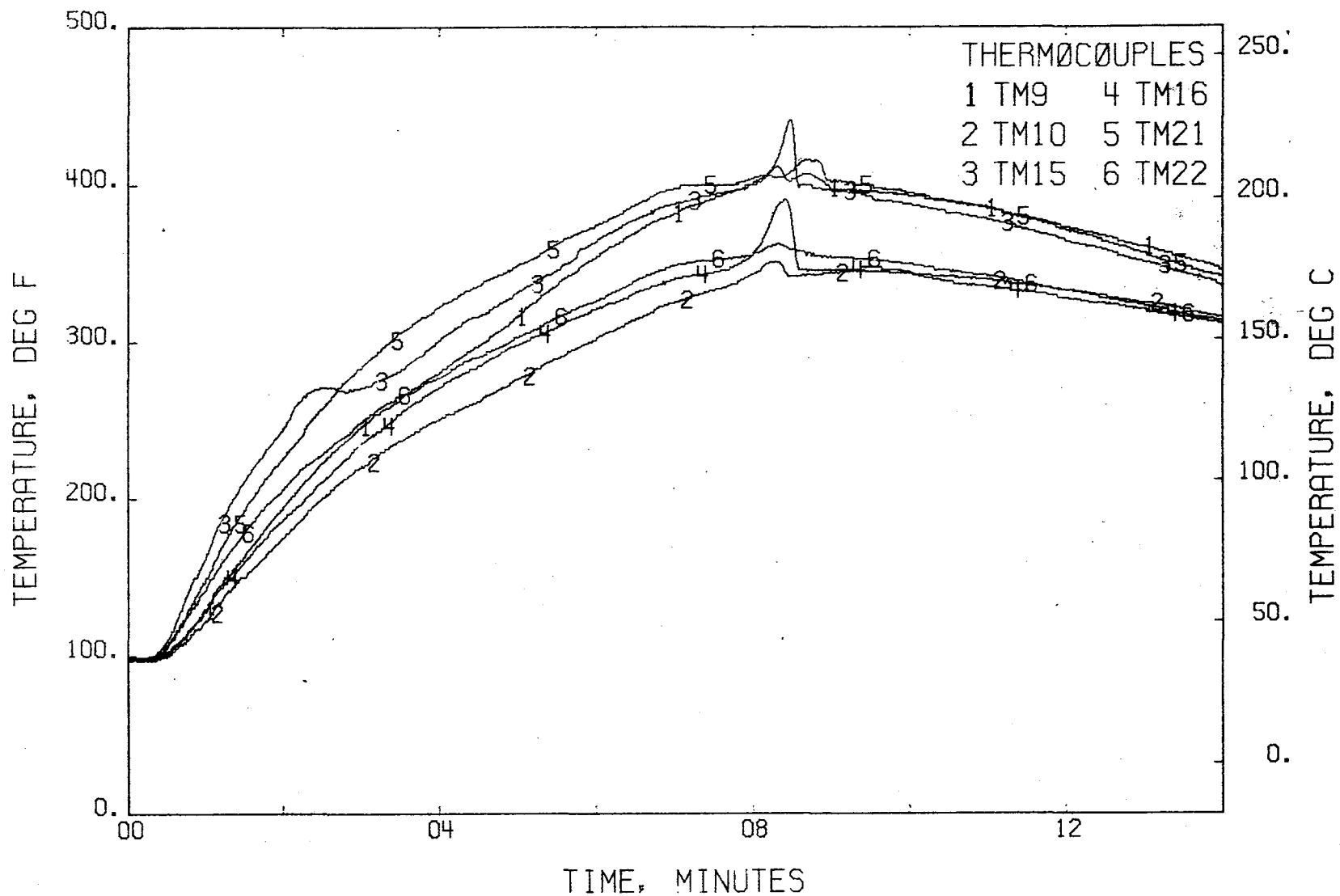


FIGURE 463 . - TEMPERATURES, CEILING PANEL (CENTER)  
TEST 21

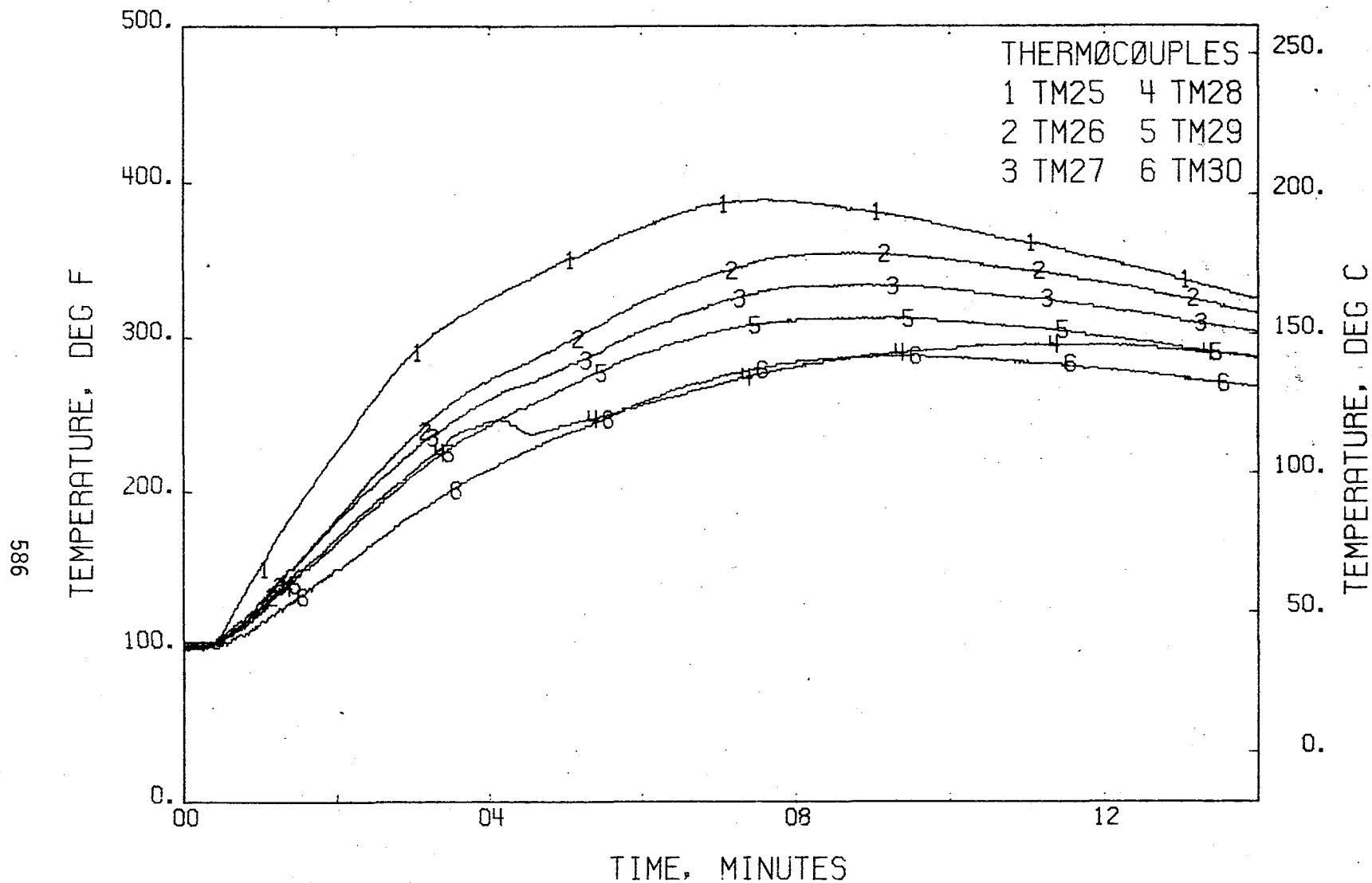


FIGURE 464 . - TEMPERATURES, CEILING PANELS (FORWARD)  
TEST 21

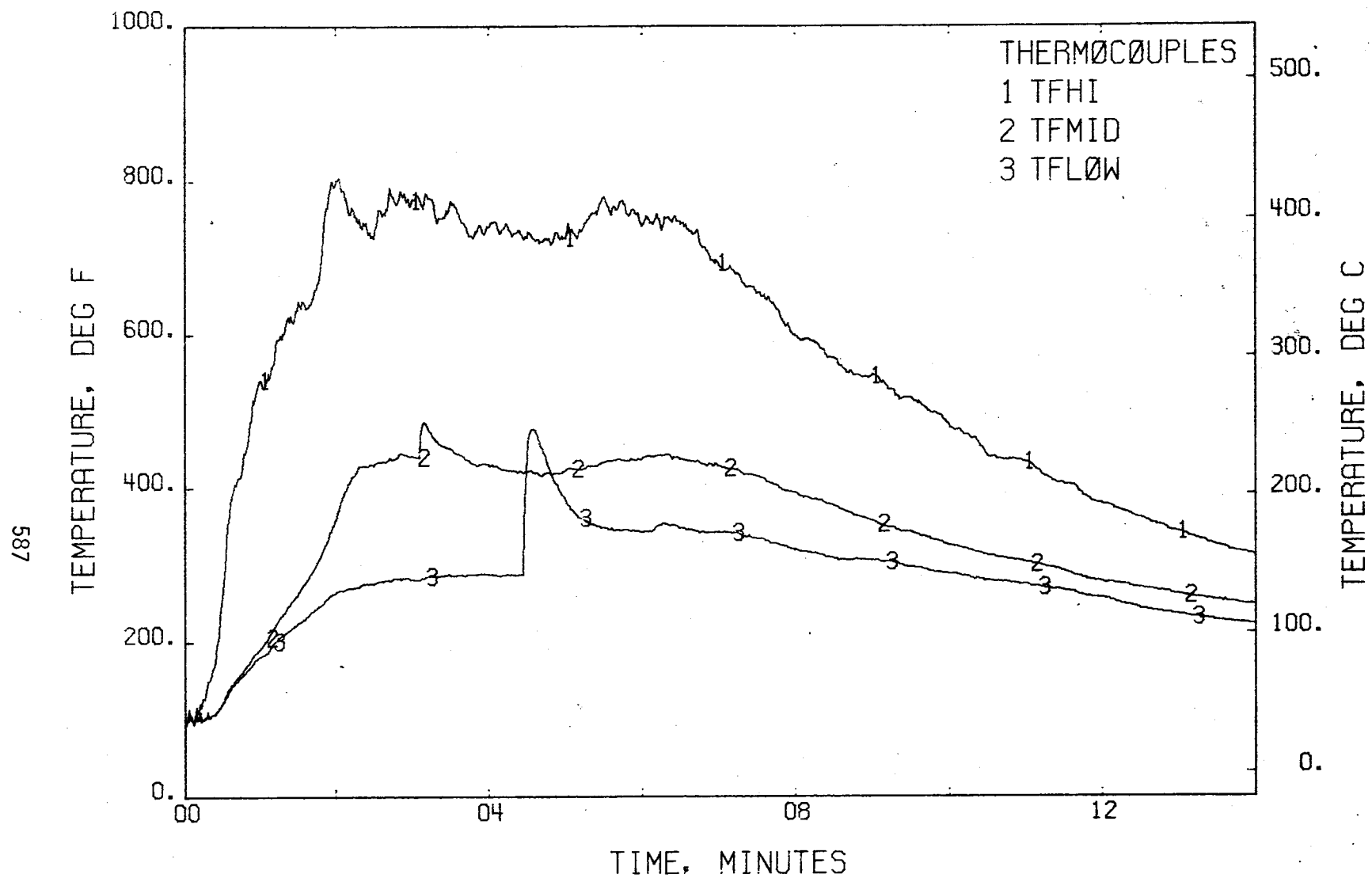


FIGURE 465 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 21

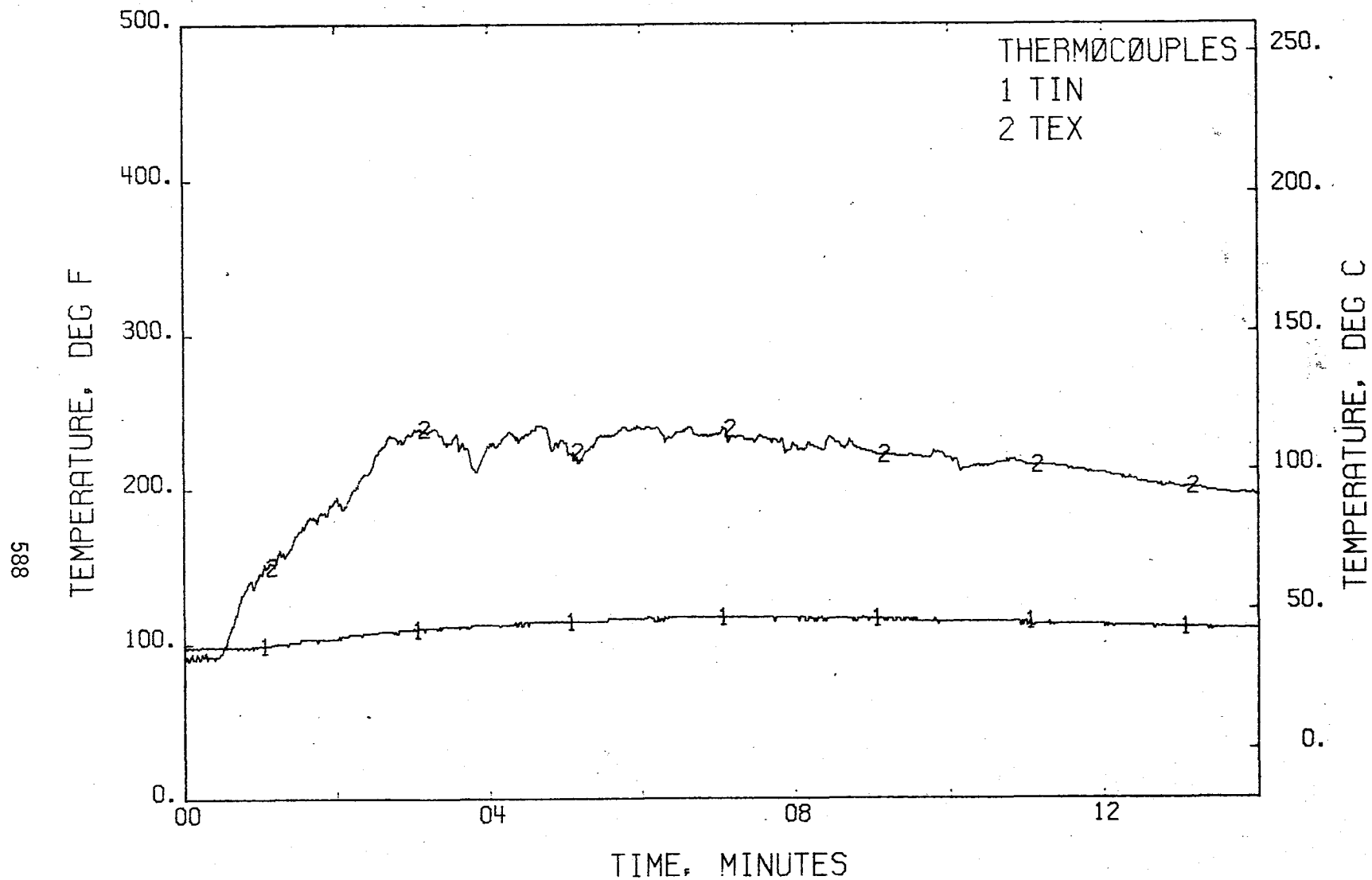


FIGURE 466 . - TEMPERATURES, INLET + EXIT  
TEST 21

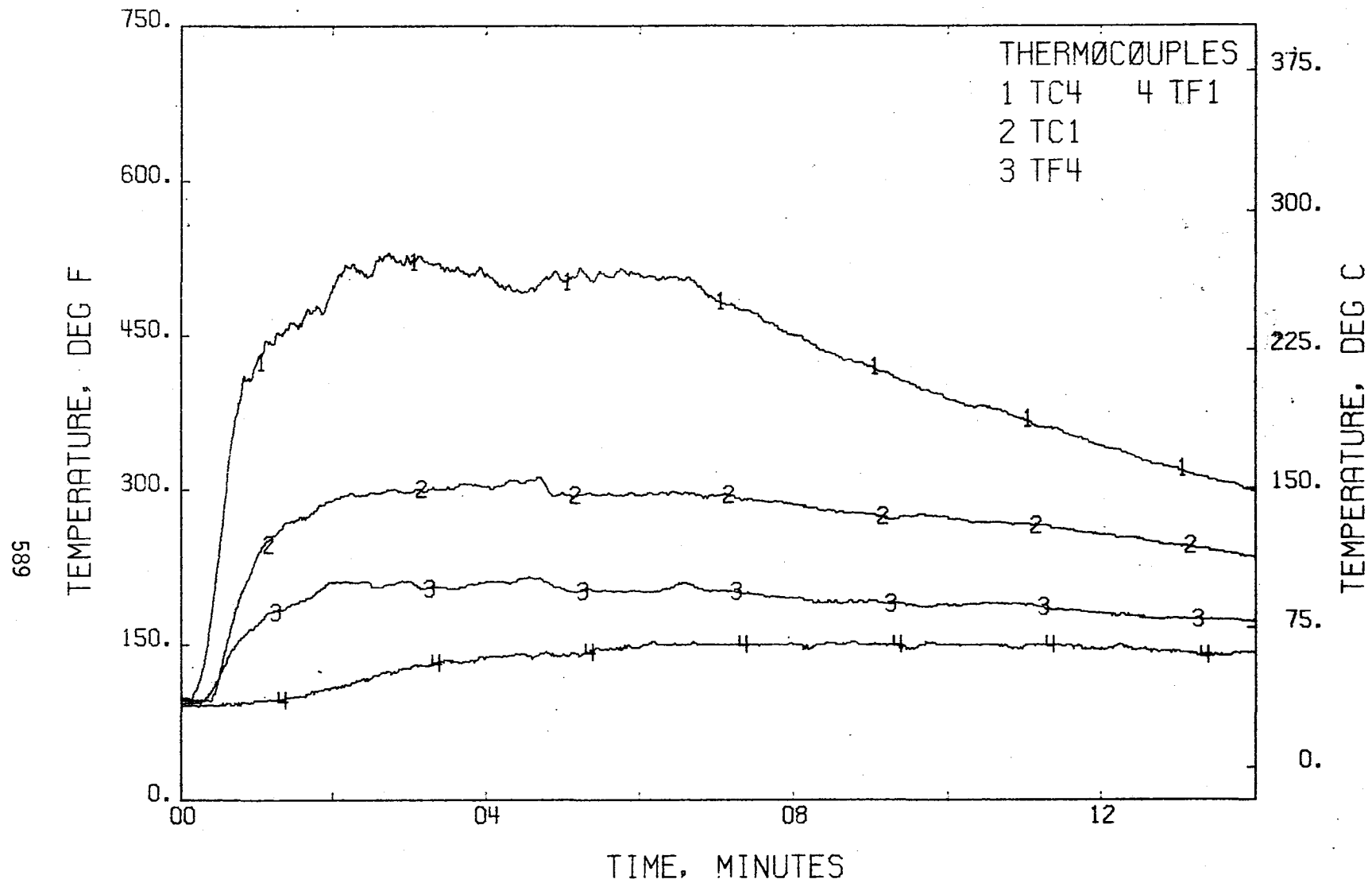


FIGURE 467 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 21

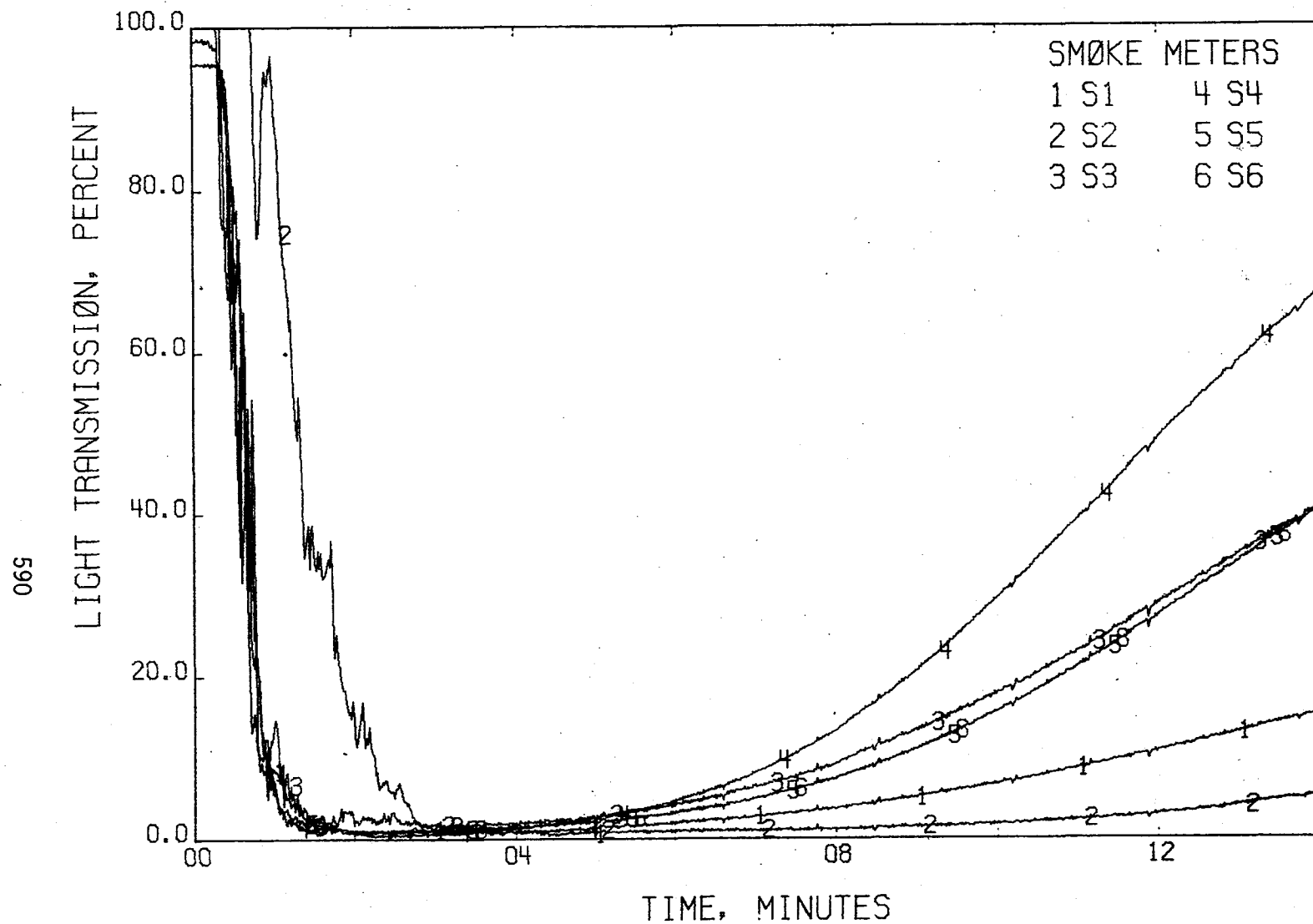


FIGURE 468 . - LIGHT TRANSMISSION  
TEST 21

169

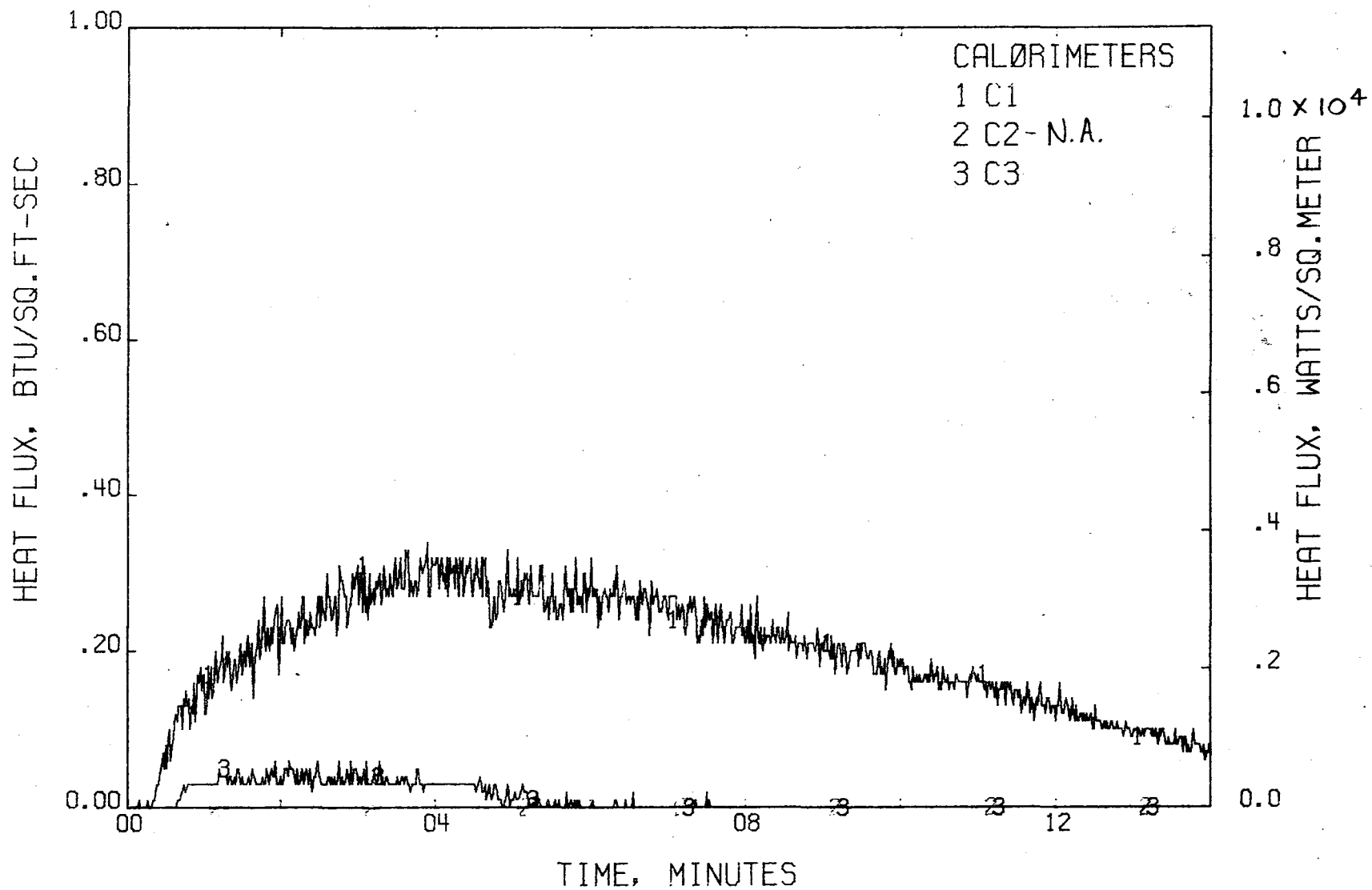
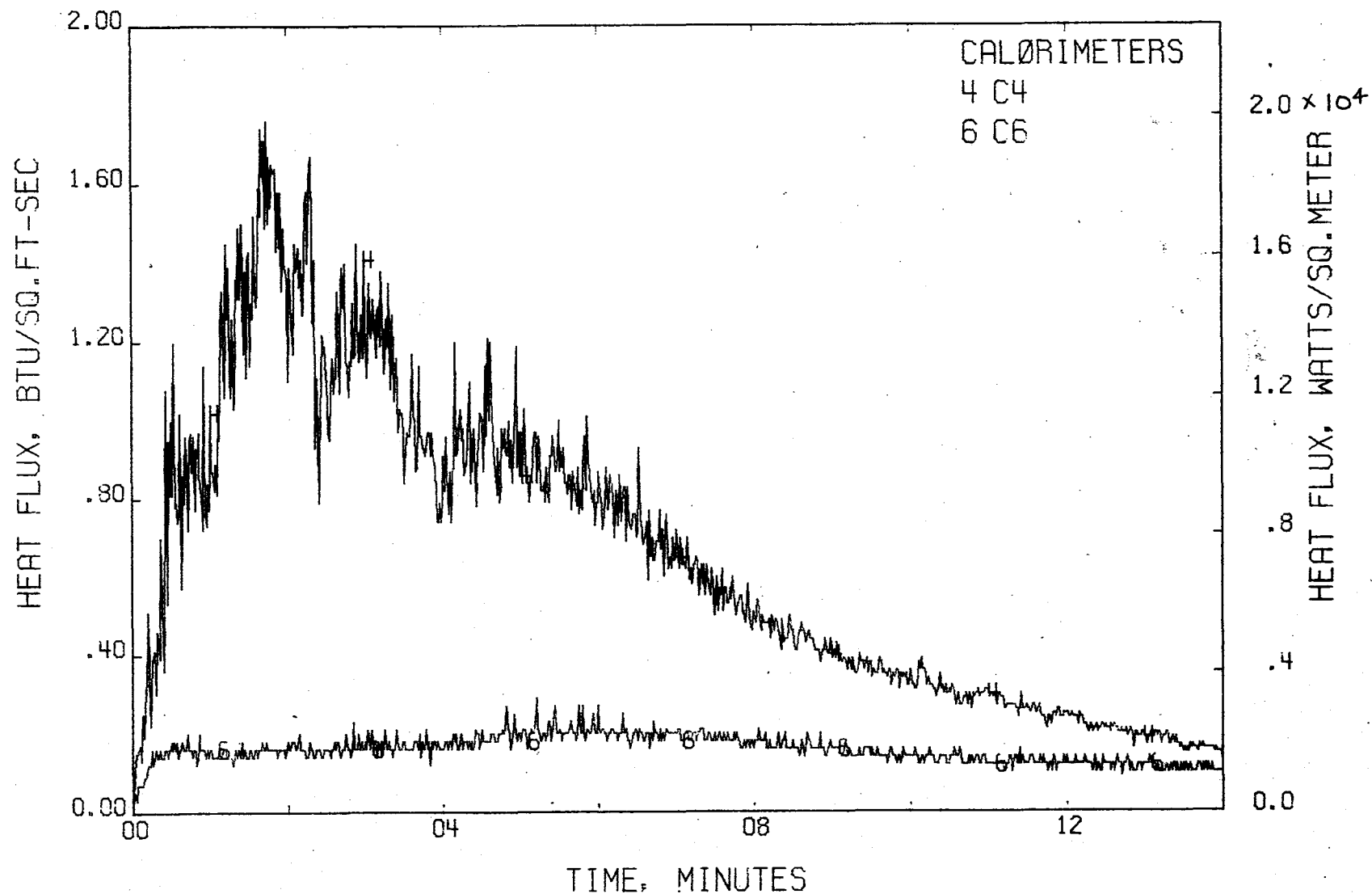


FIGURE 469 . - HEAT FLUX, AFT  
TEST 21





593

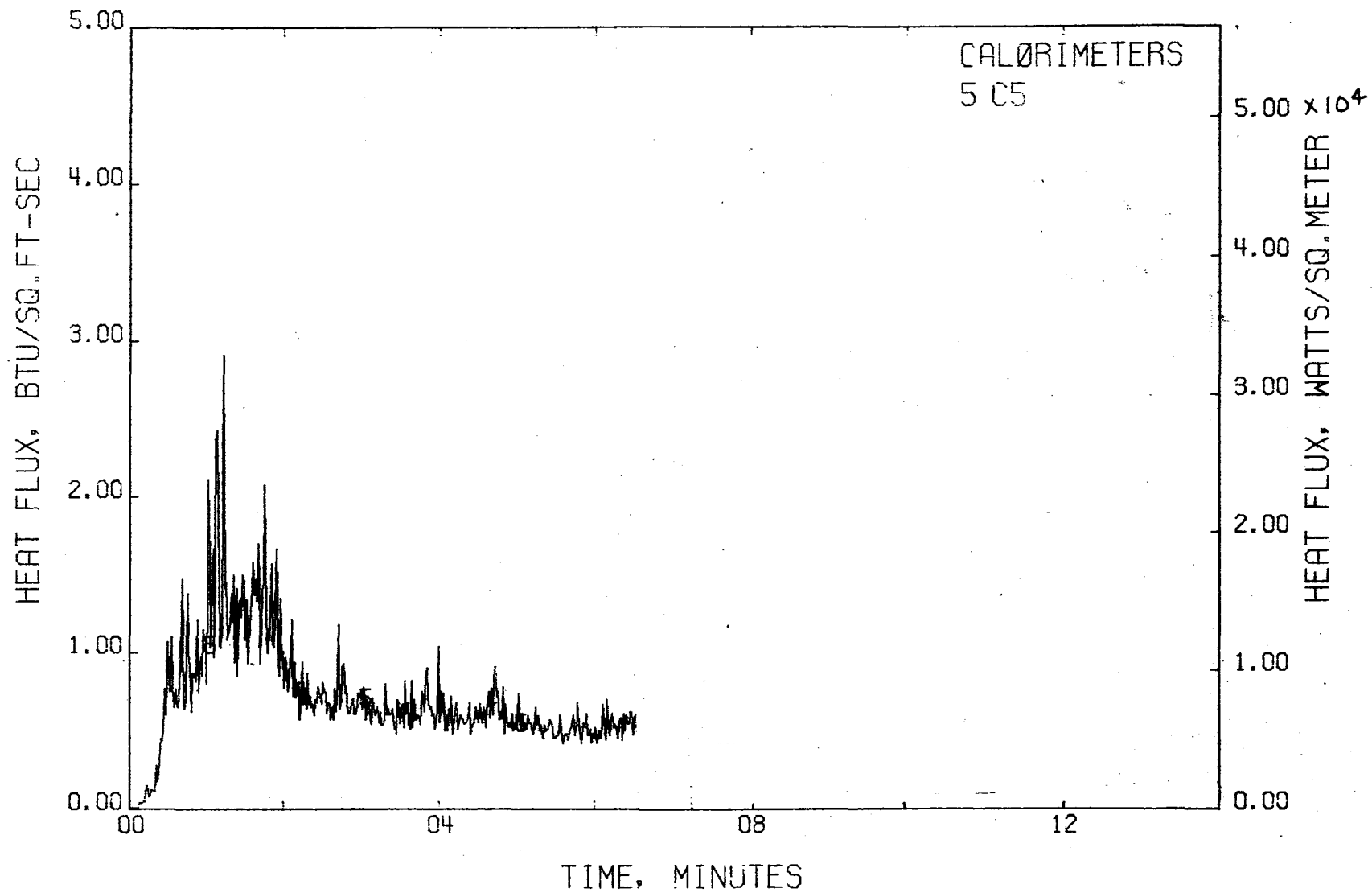


FIGURE 470 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 21

594

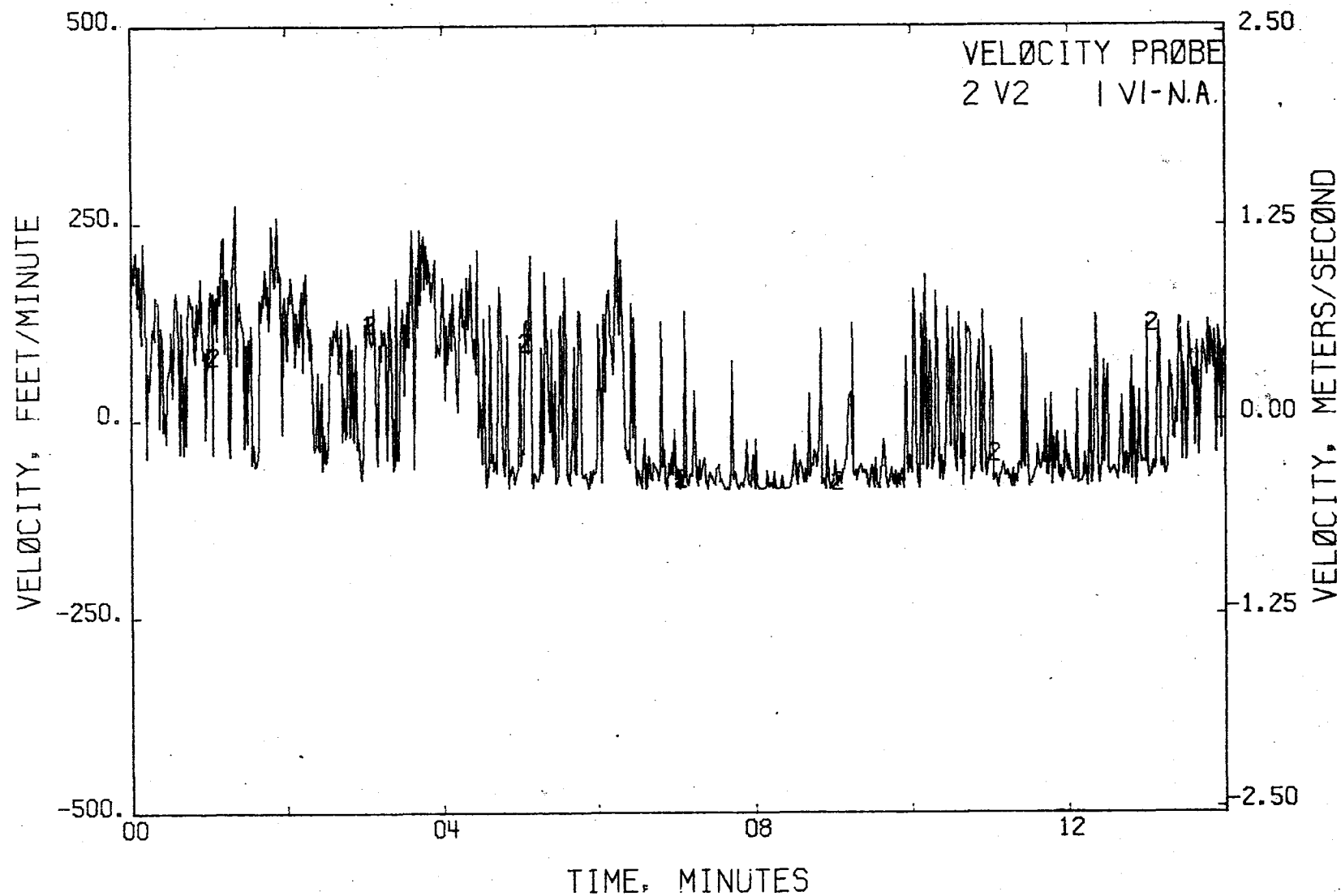


FIGURE 471 . - AIR VELOCITY  
TEST 21

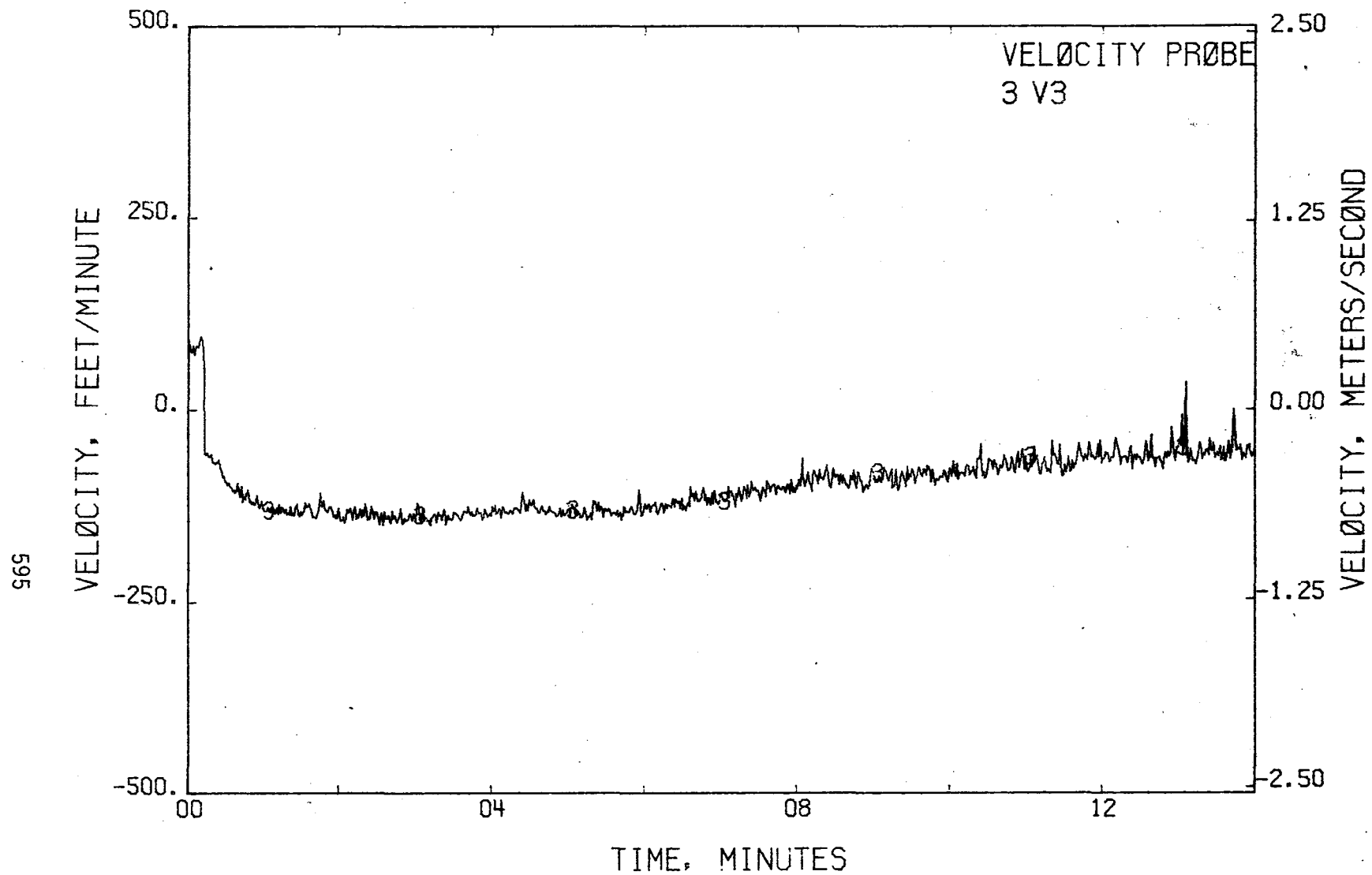


FIGURE 471 . - AIR VELOCITY - CONT.  
TEST 21

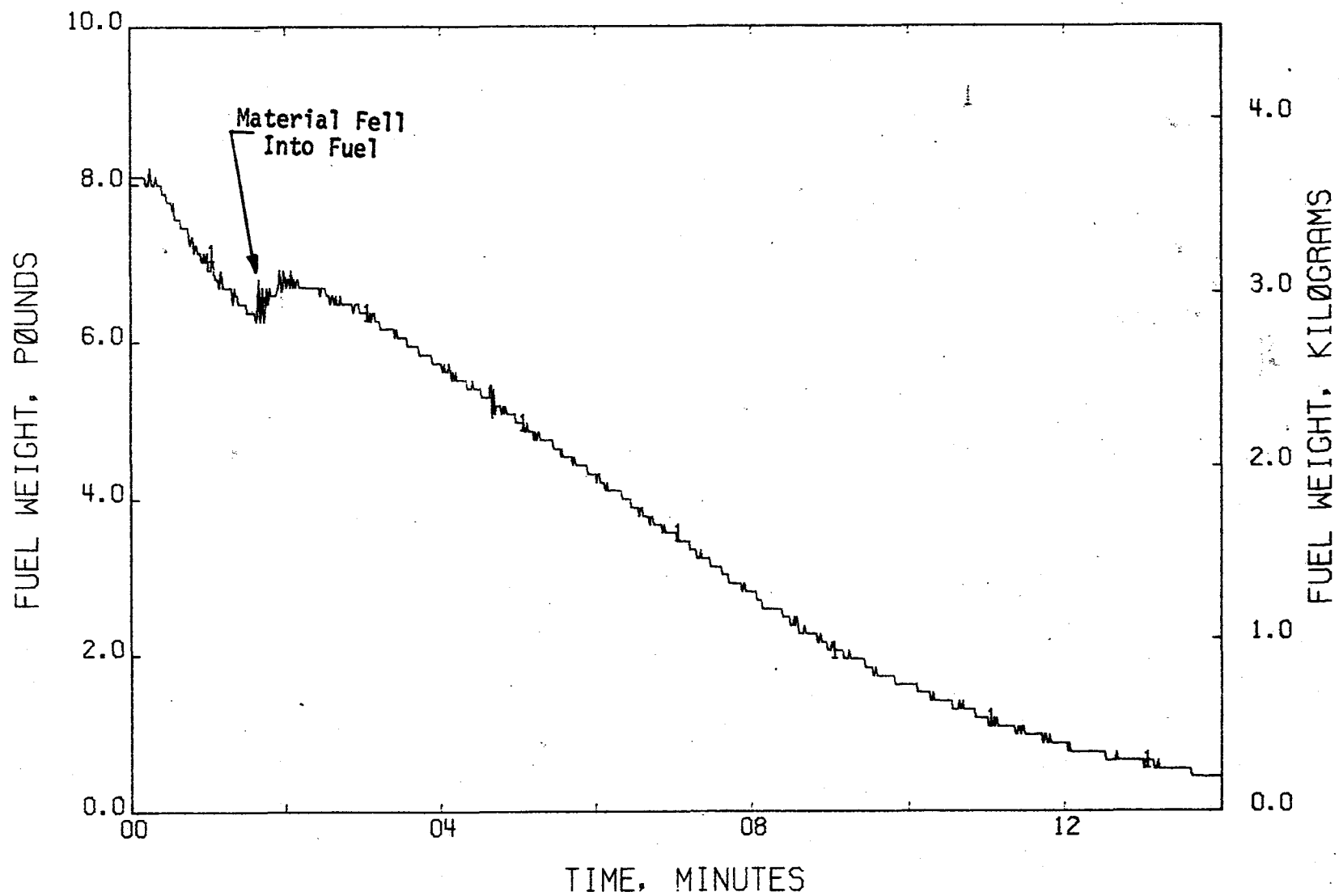


FIGURE 472 . - FUEL WEIGHT LOSS  
TEST 21

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 3 PPM

597

FIGURE 473 . - HYDROGEN CYANIDE CONCENTRATIONS  
TEST 21

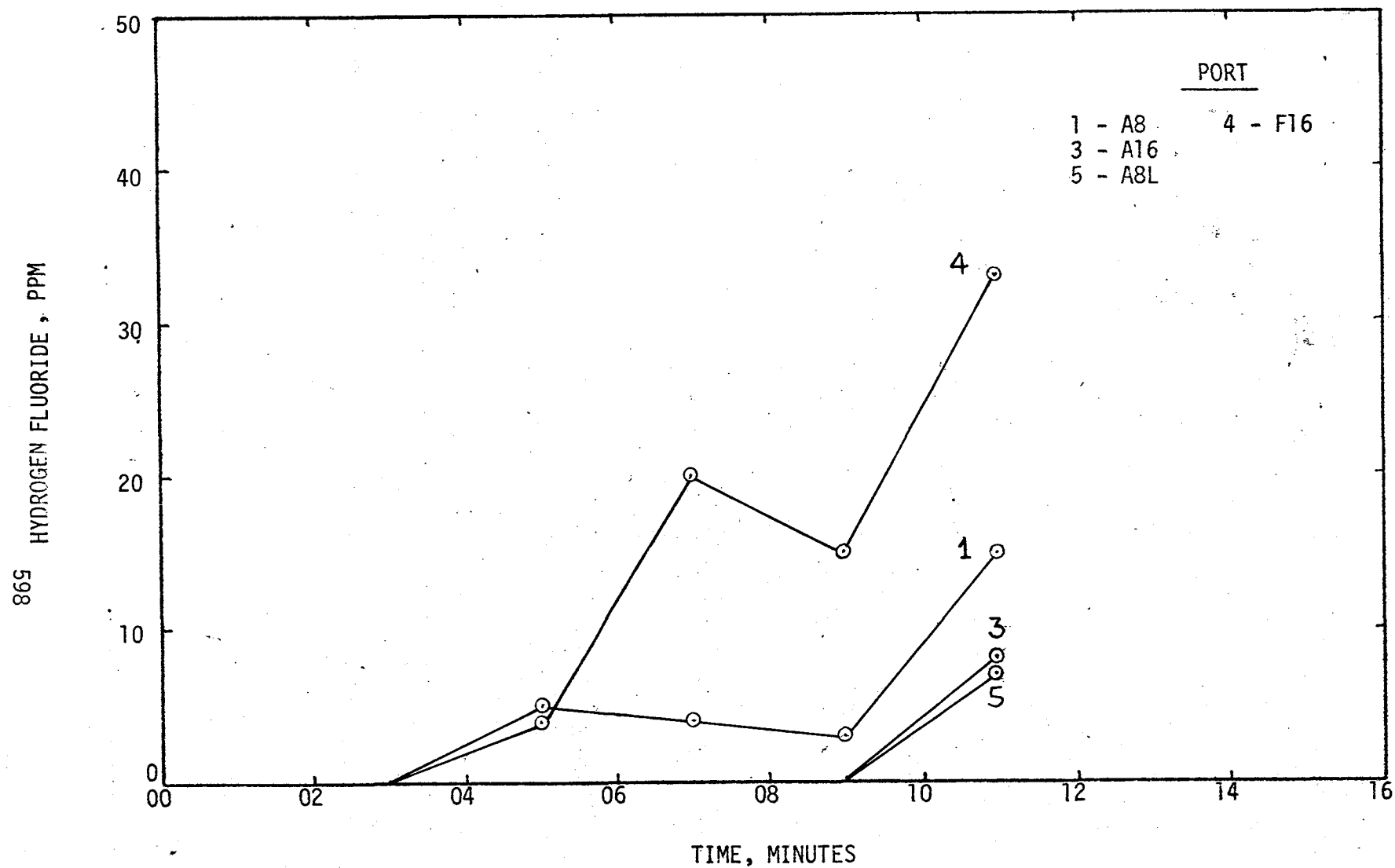


FIGURE 474 : - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 21

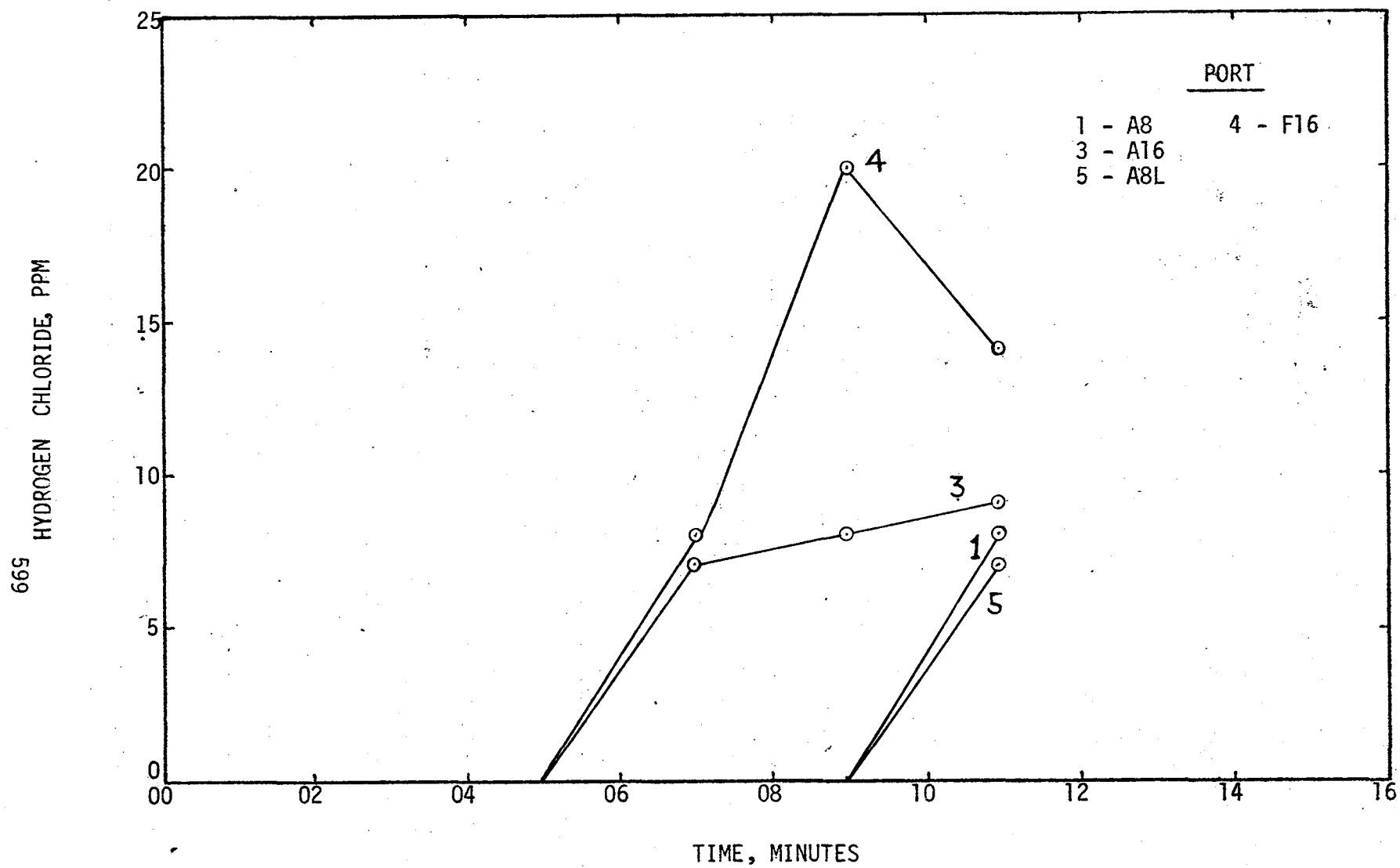


FIGURE 475 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 21

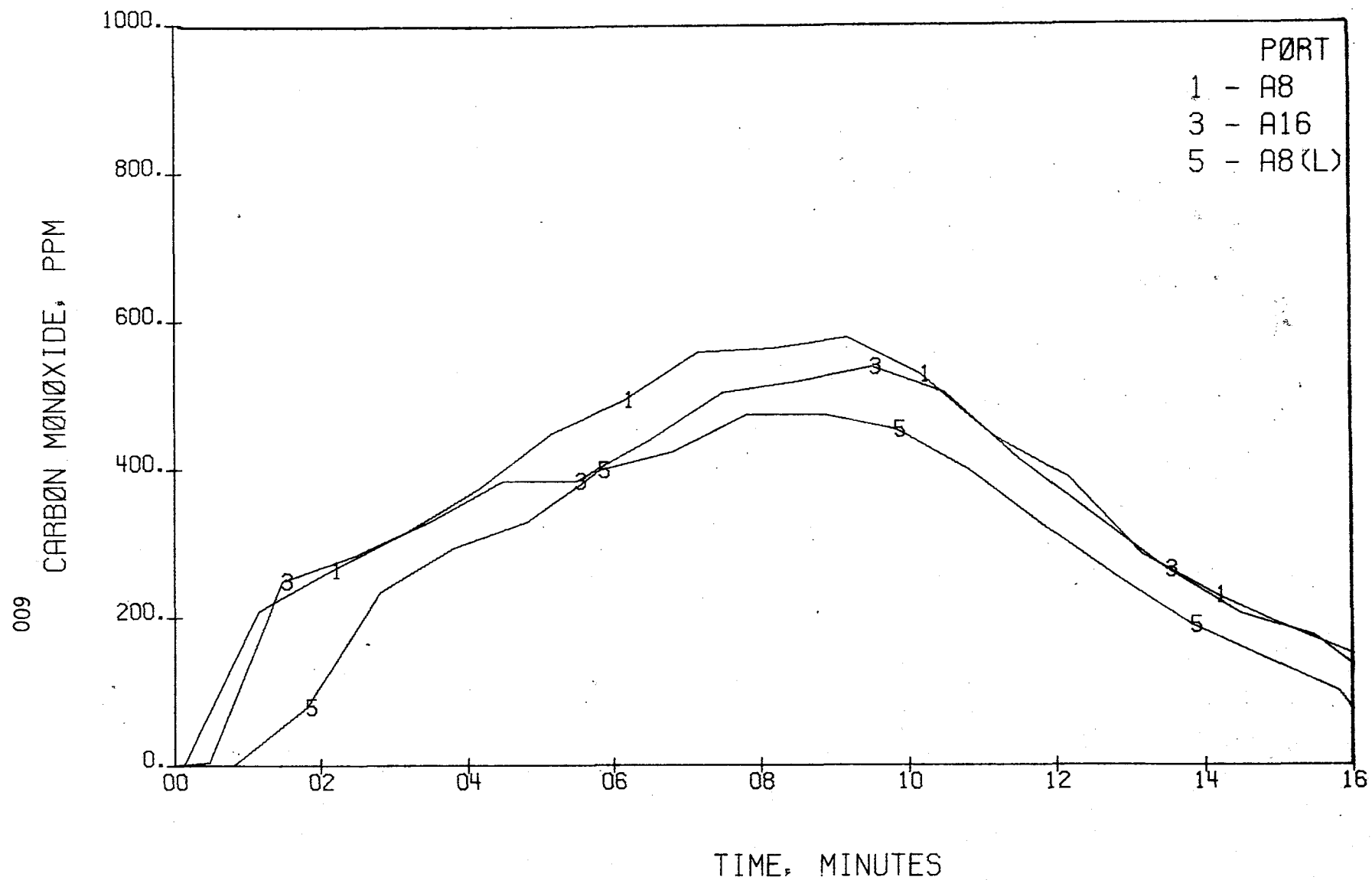


FIGURE 476 . - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 21



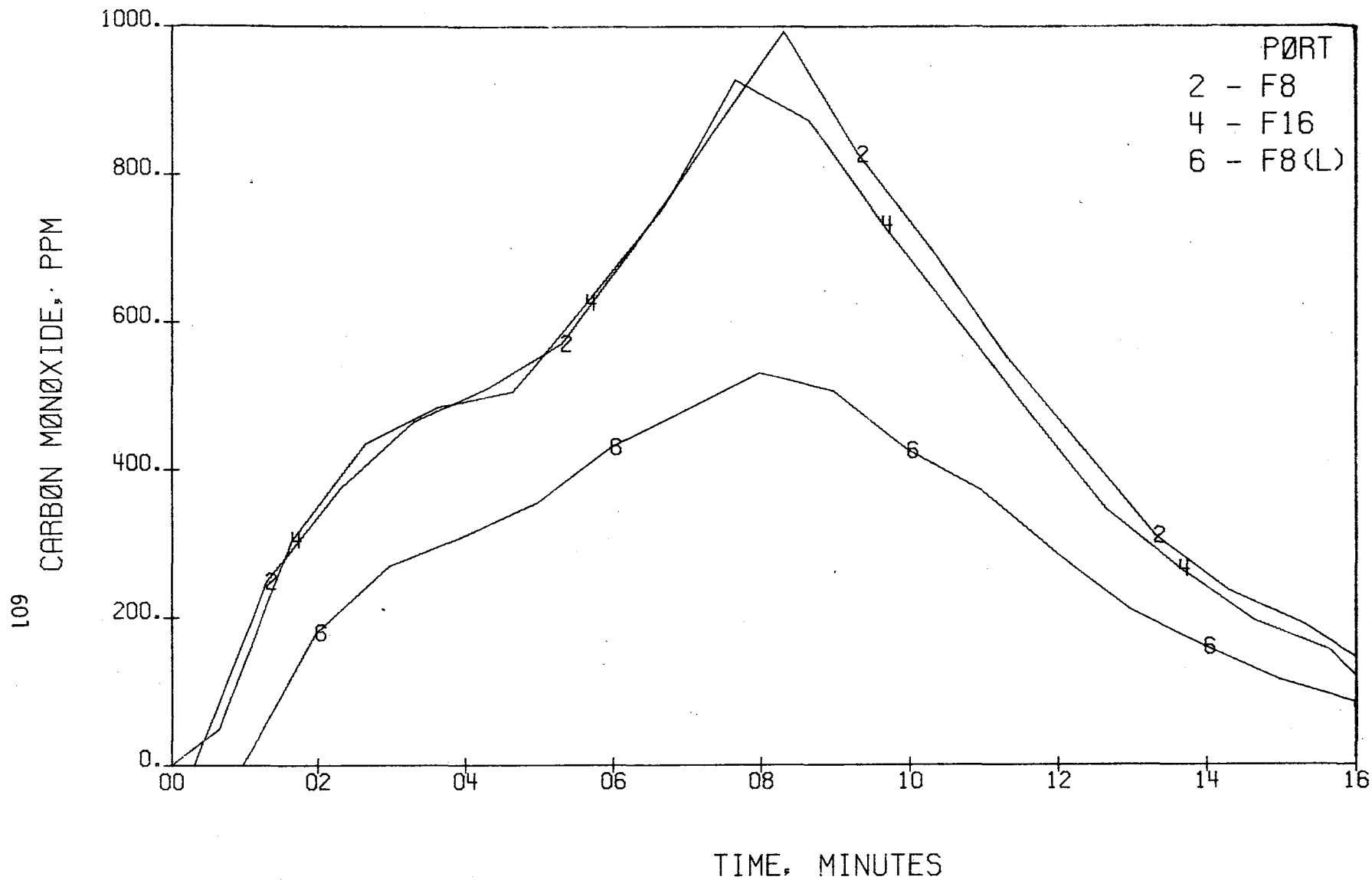


FIGURE 477 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 21

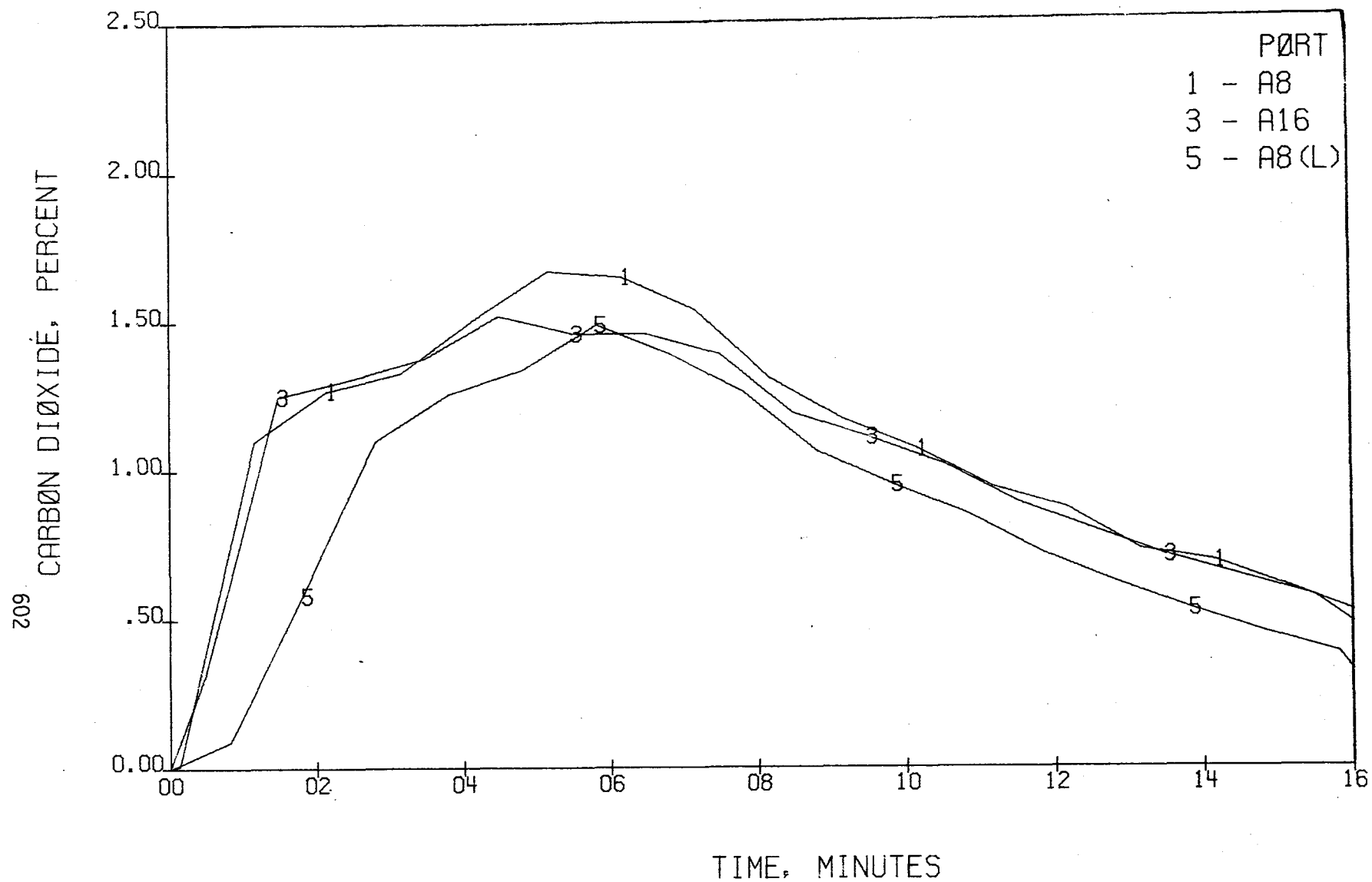


FIGURE 478 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 21

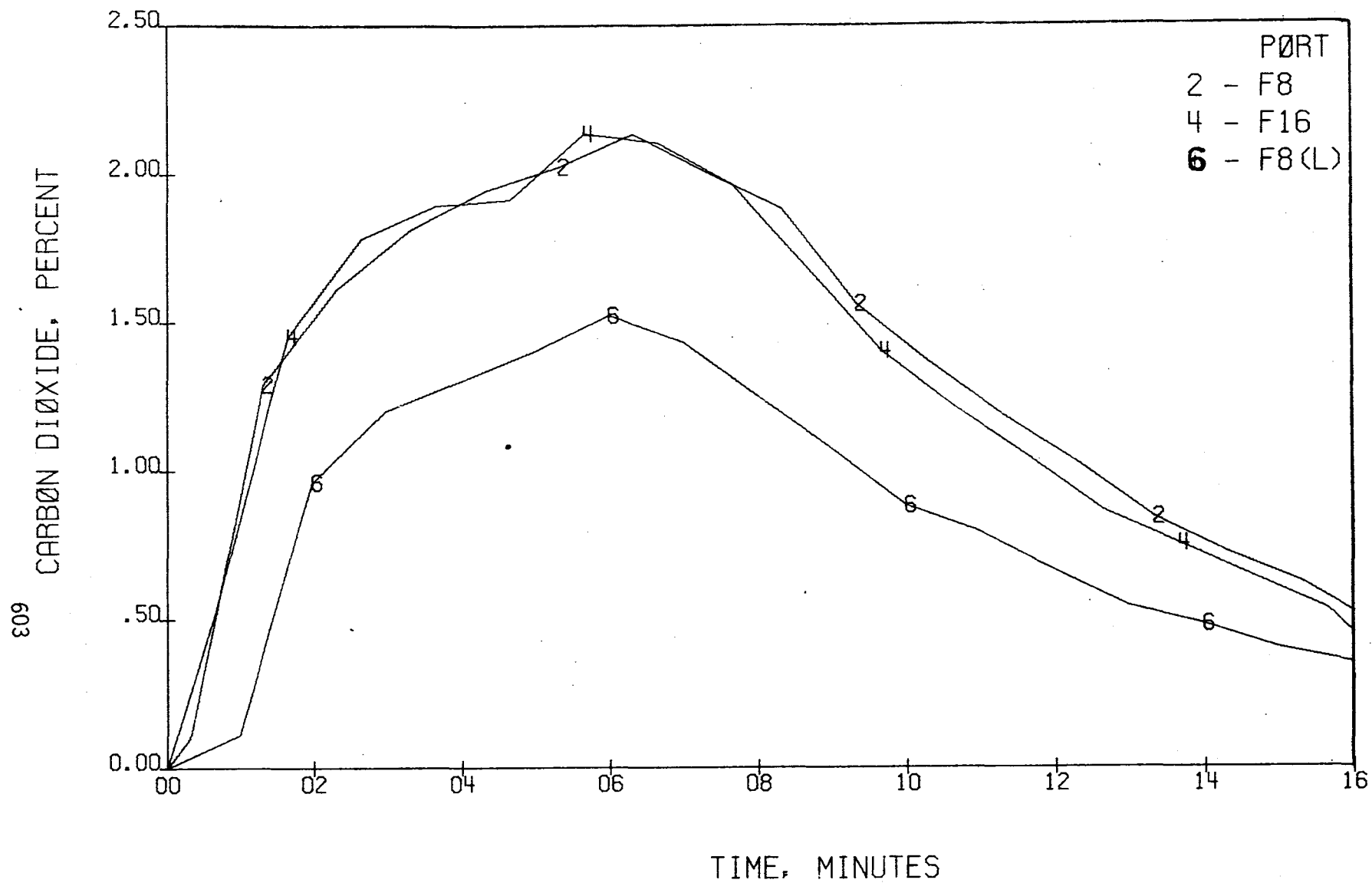


FIGURE 479 . - CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 21

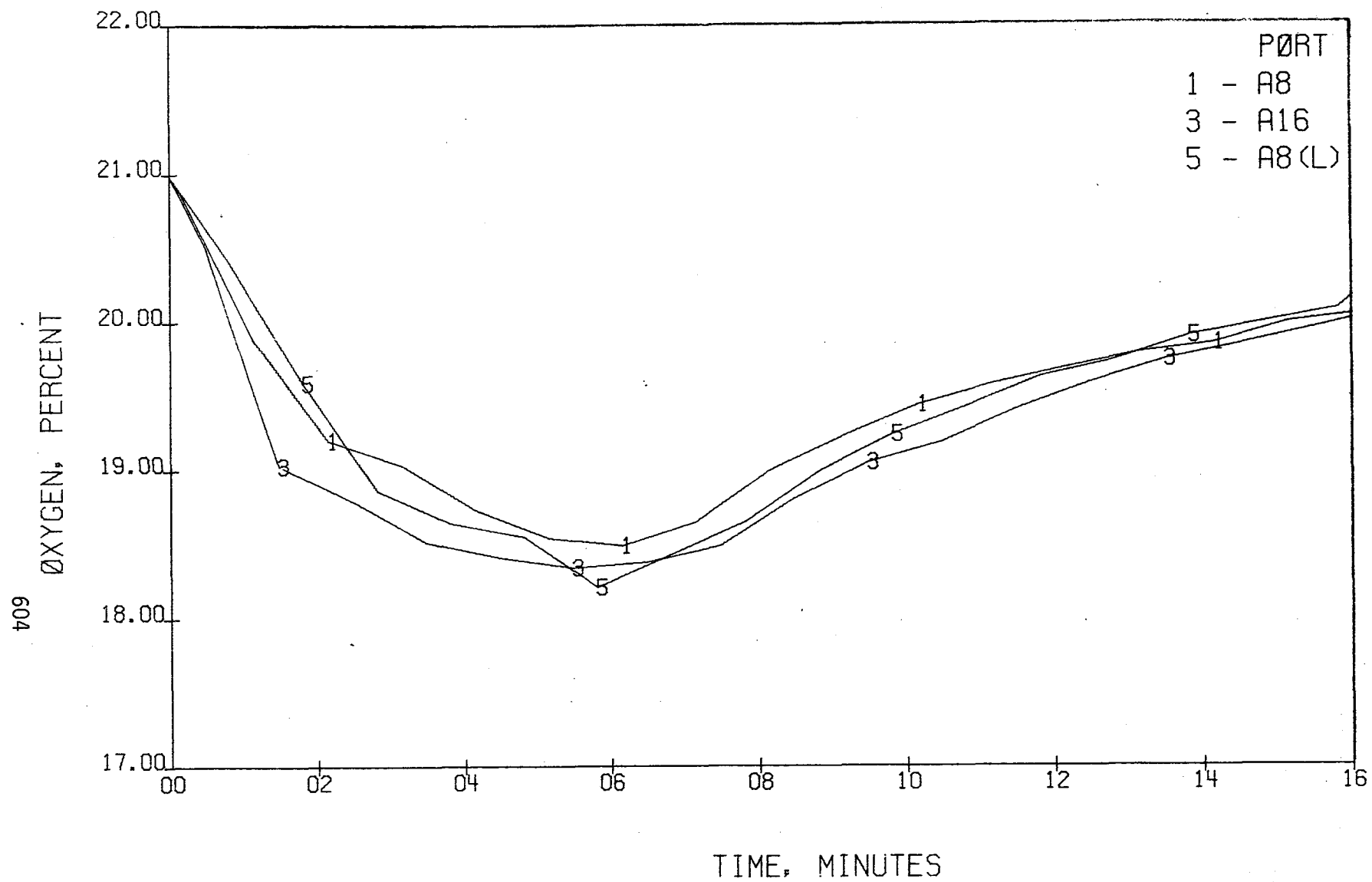


FIGURE 480 . - OXYGEN CONCENTRATIONS , AFT  
TEST 21

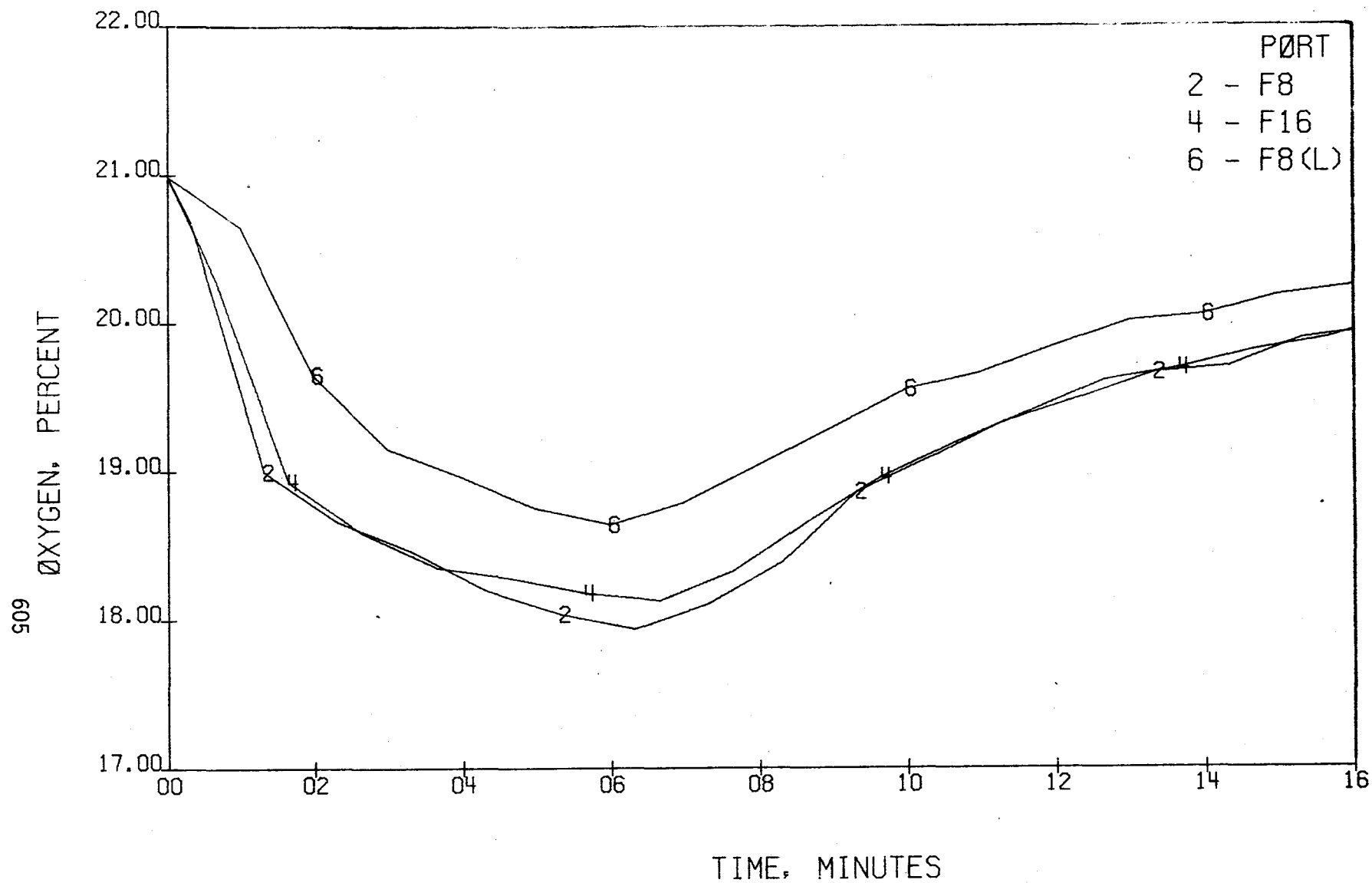


FIGURE 481 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 21

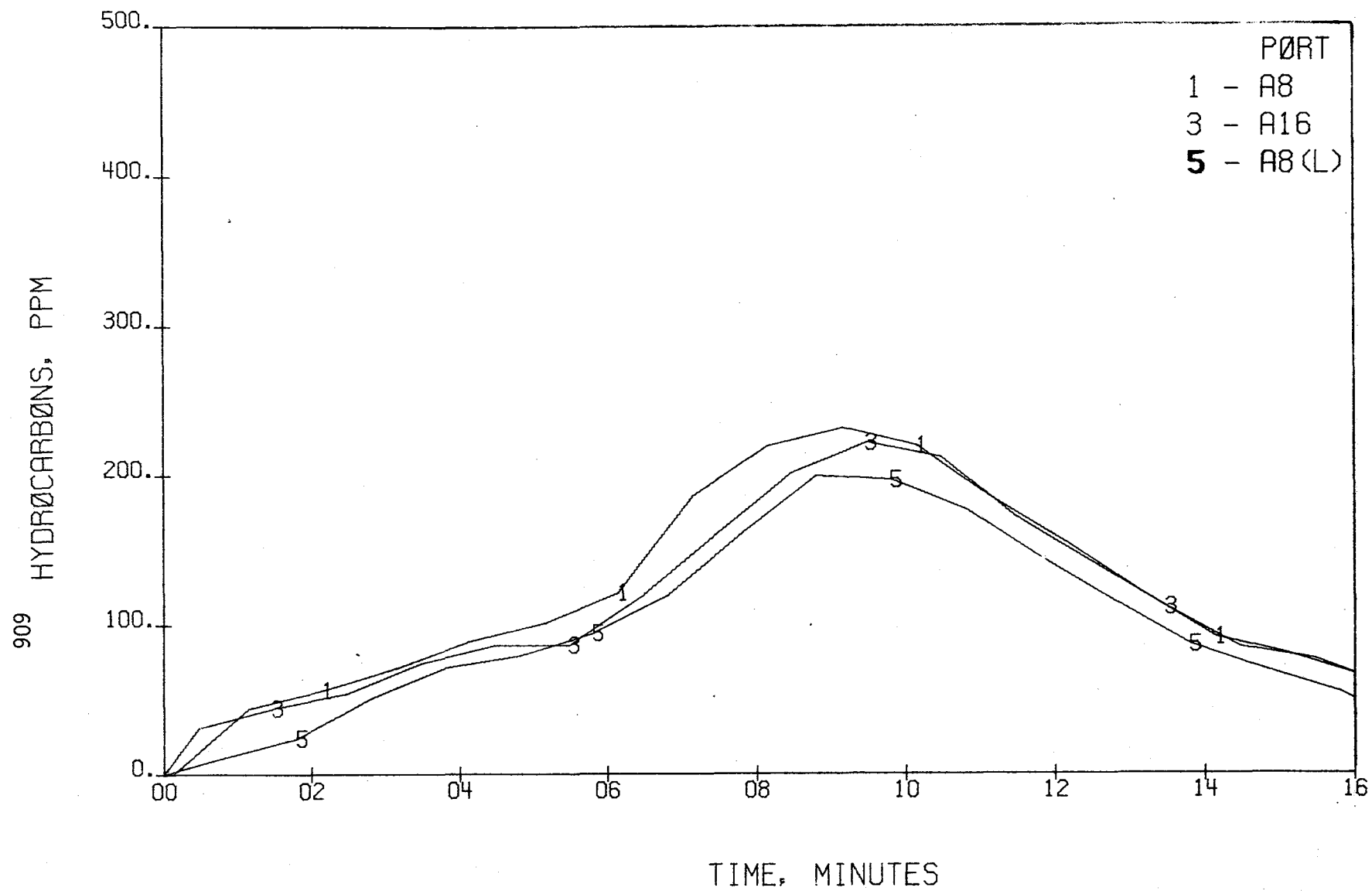


FIGURE 482. - HYDROCARBONS CONCENTRATIONS, AFT TEST 21

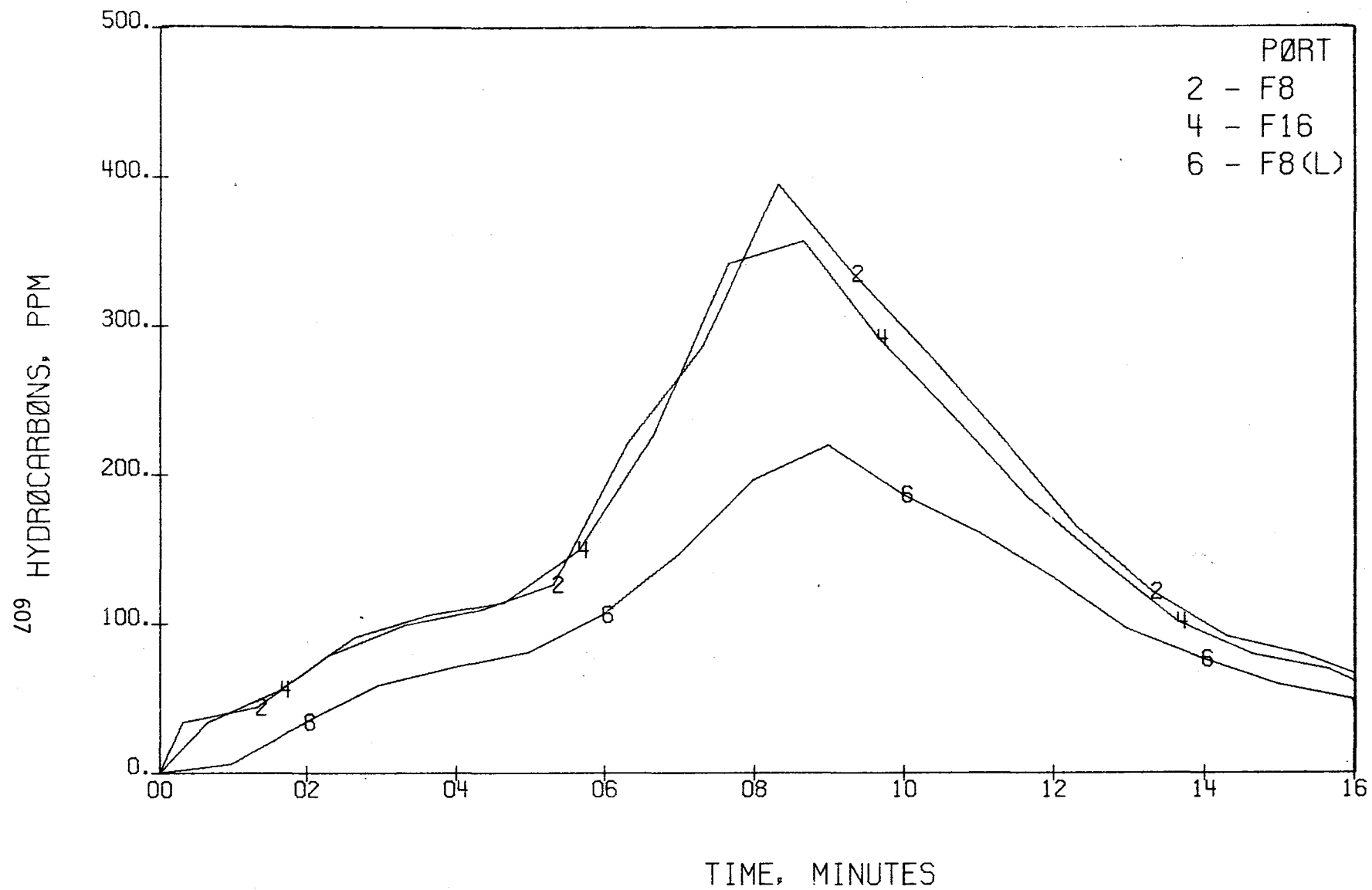


FIGURE 483 . - HYDROCARBONS CONCENTRATIONS , FØRE  
TEST 21





TEST 22  

---

FUEL ONLY

NO PHOTOS WERE TAKEN FOR TEST 22

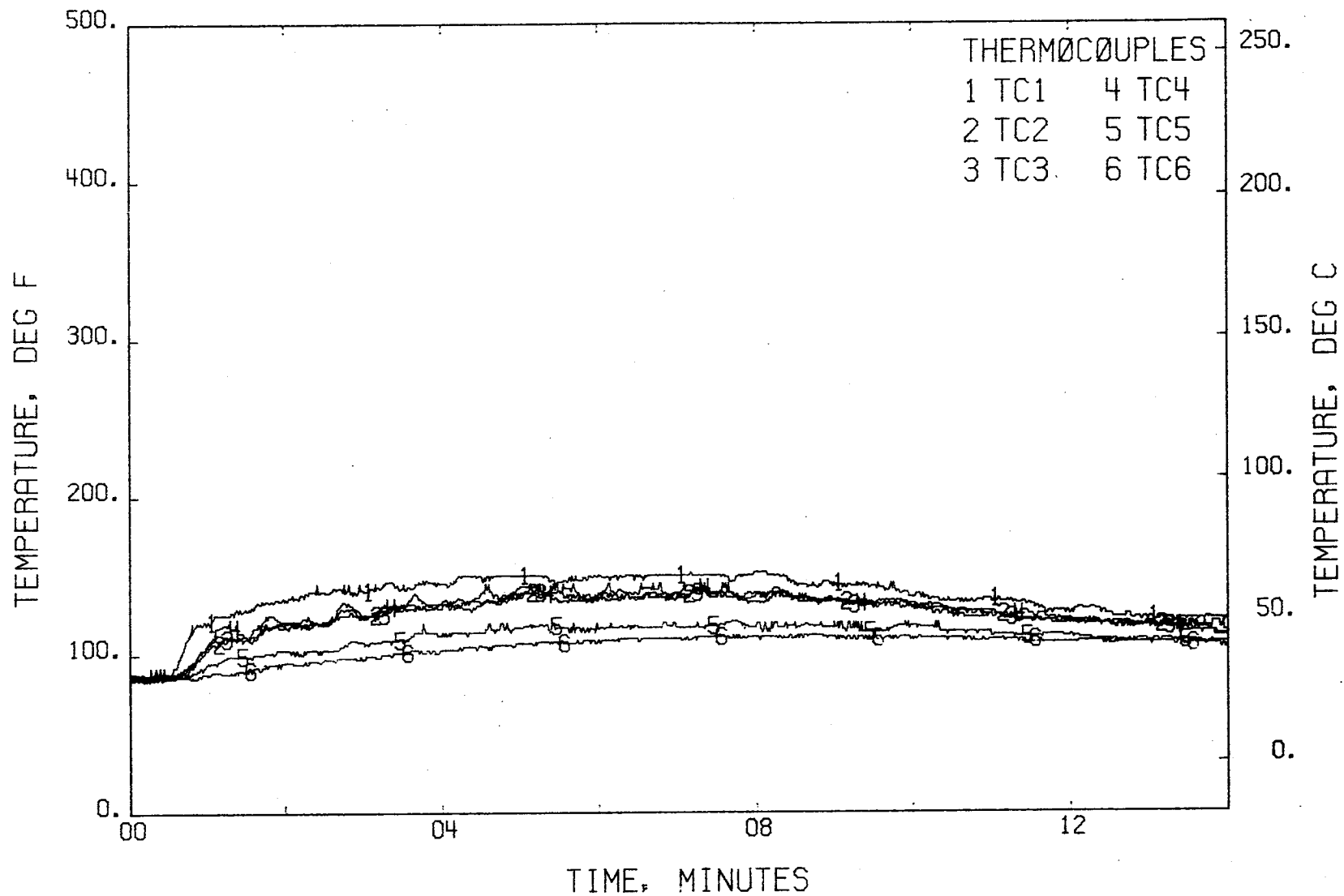


FIGURE 484 . - TEMPERATURES, T/C TREE 1  
TEST 22

612

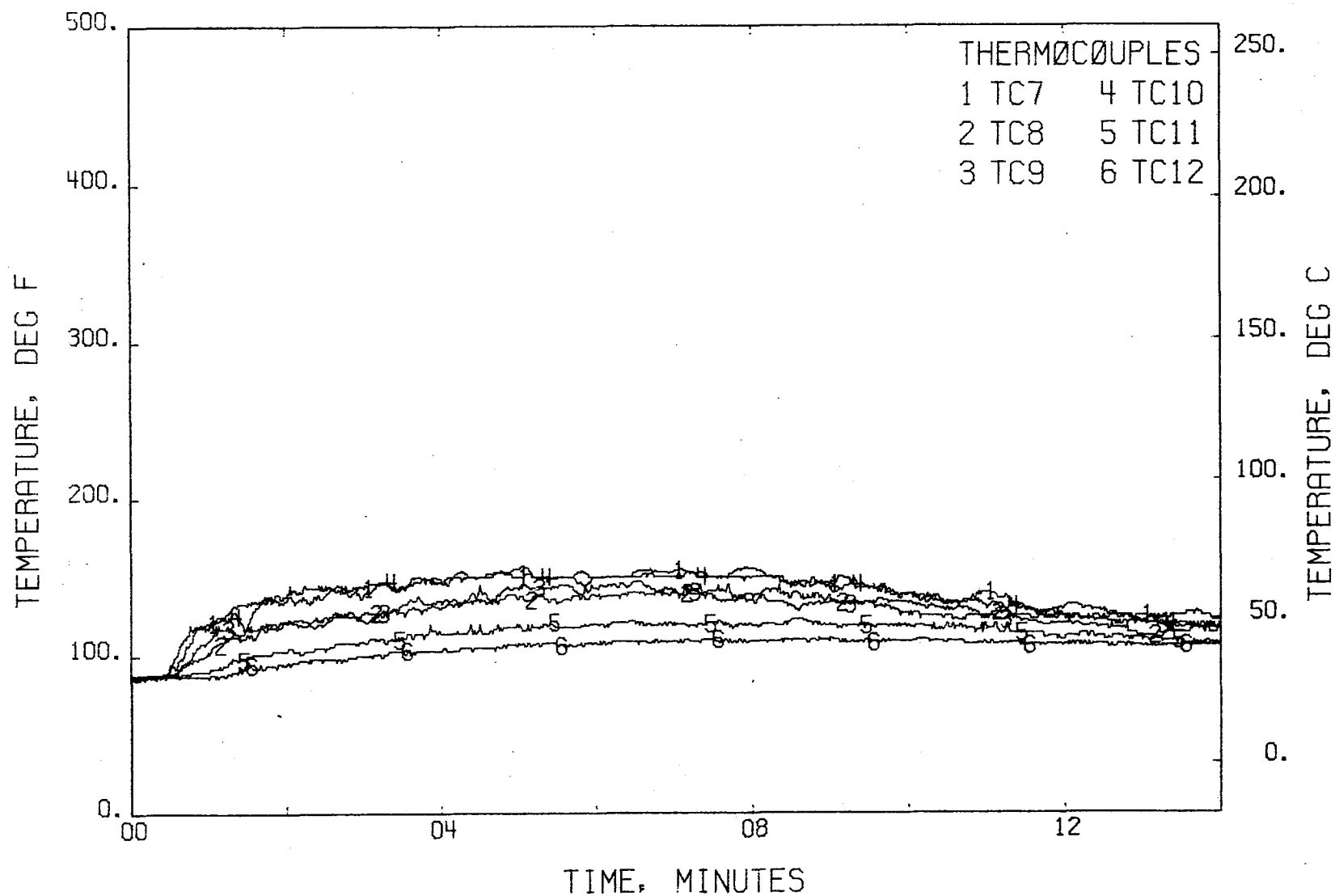


FIGURE 485 . - TEMPERATURES, T/C TREE 2  
TEST 22

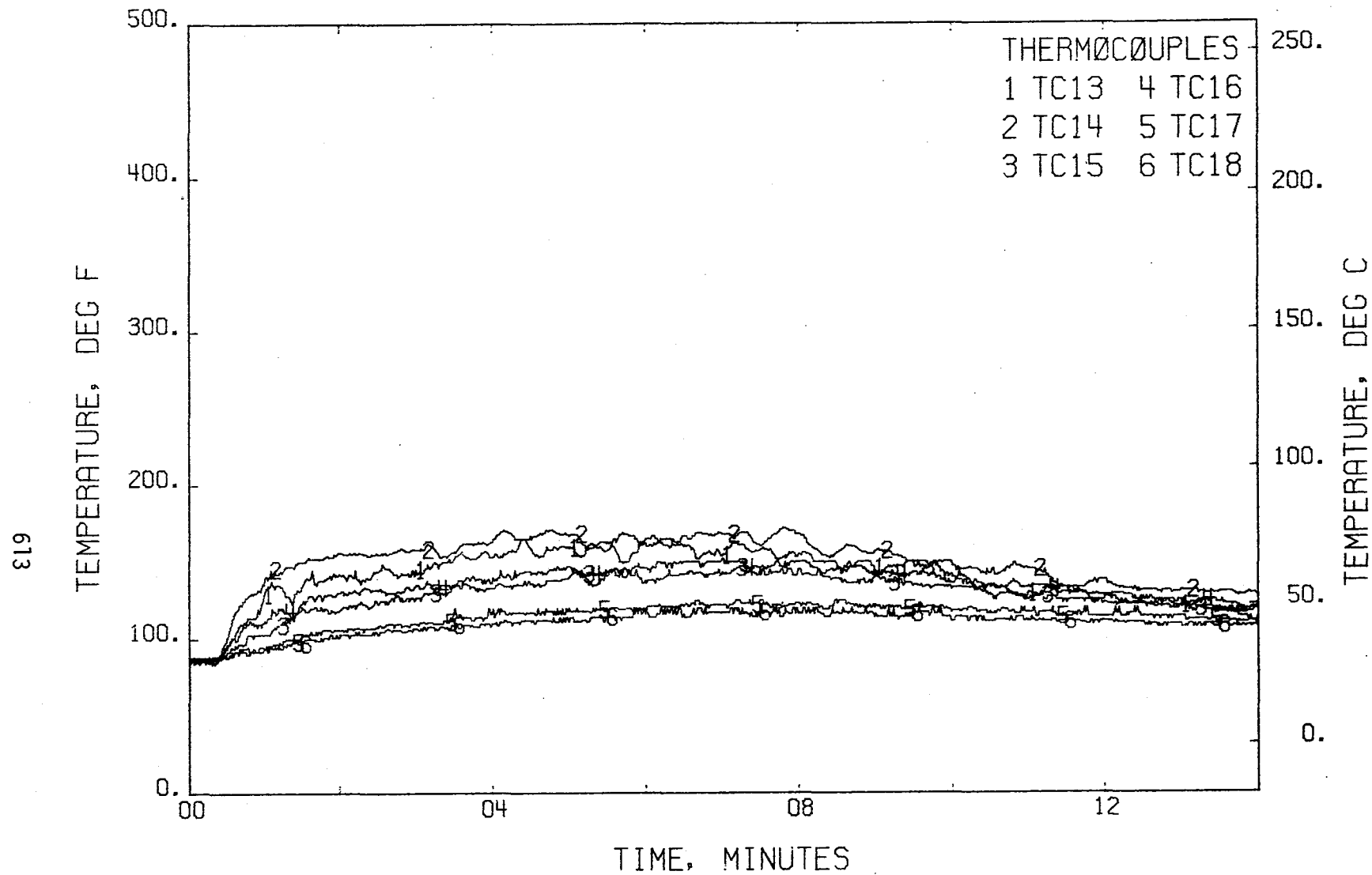


FIGURE 486 . - TEMPERATURES, T/C TREE 3  
TEST 22

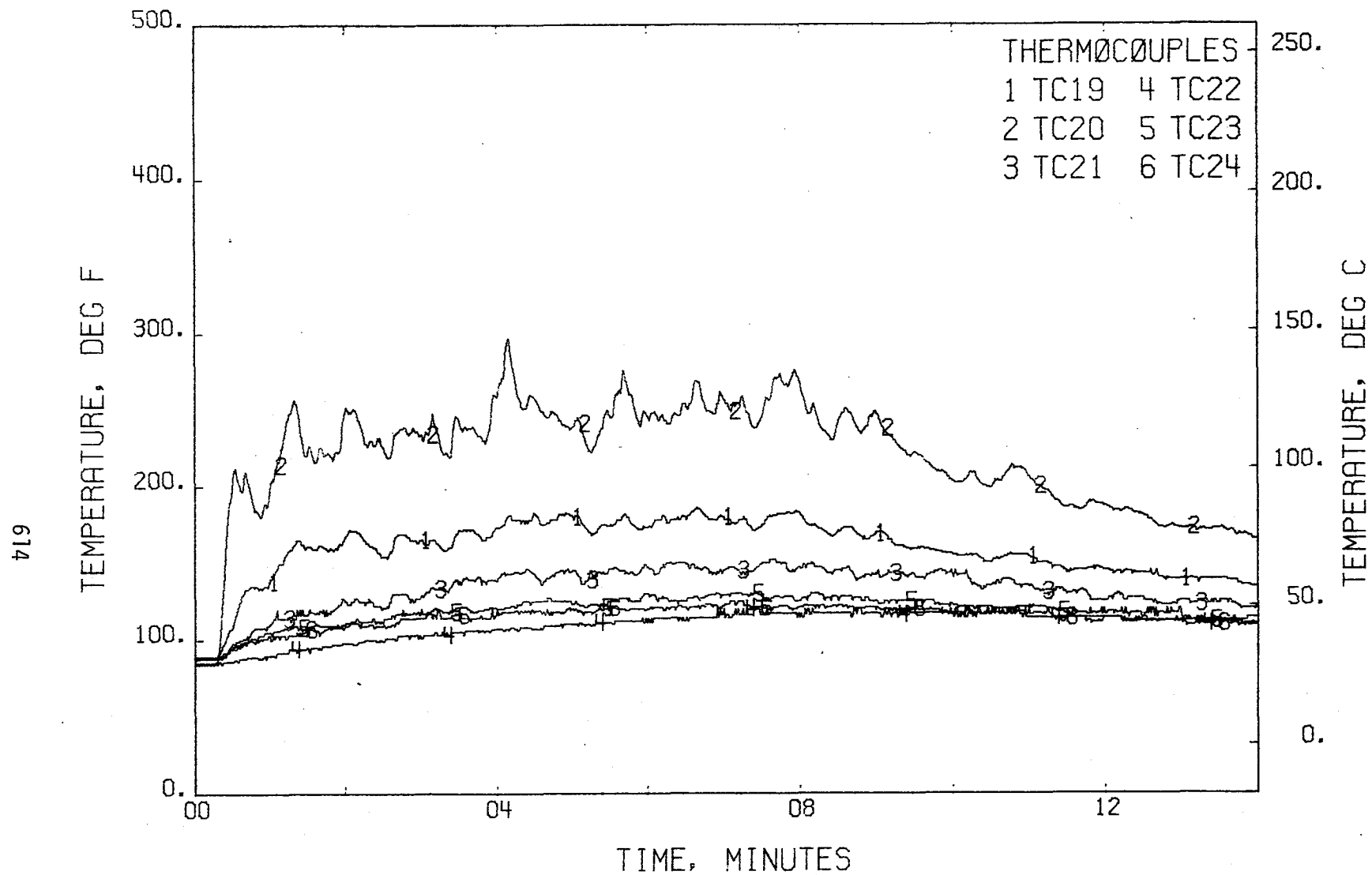


FIGURE 487 . - TEMPERATURES, T/C TREE 4  
TEST 22

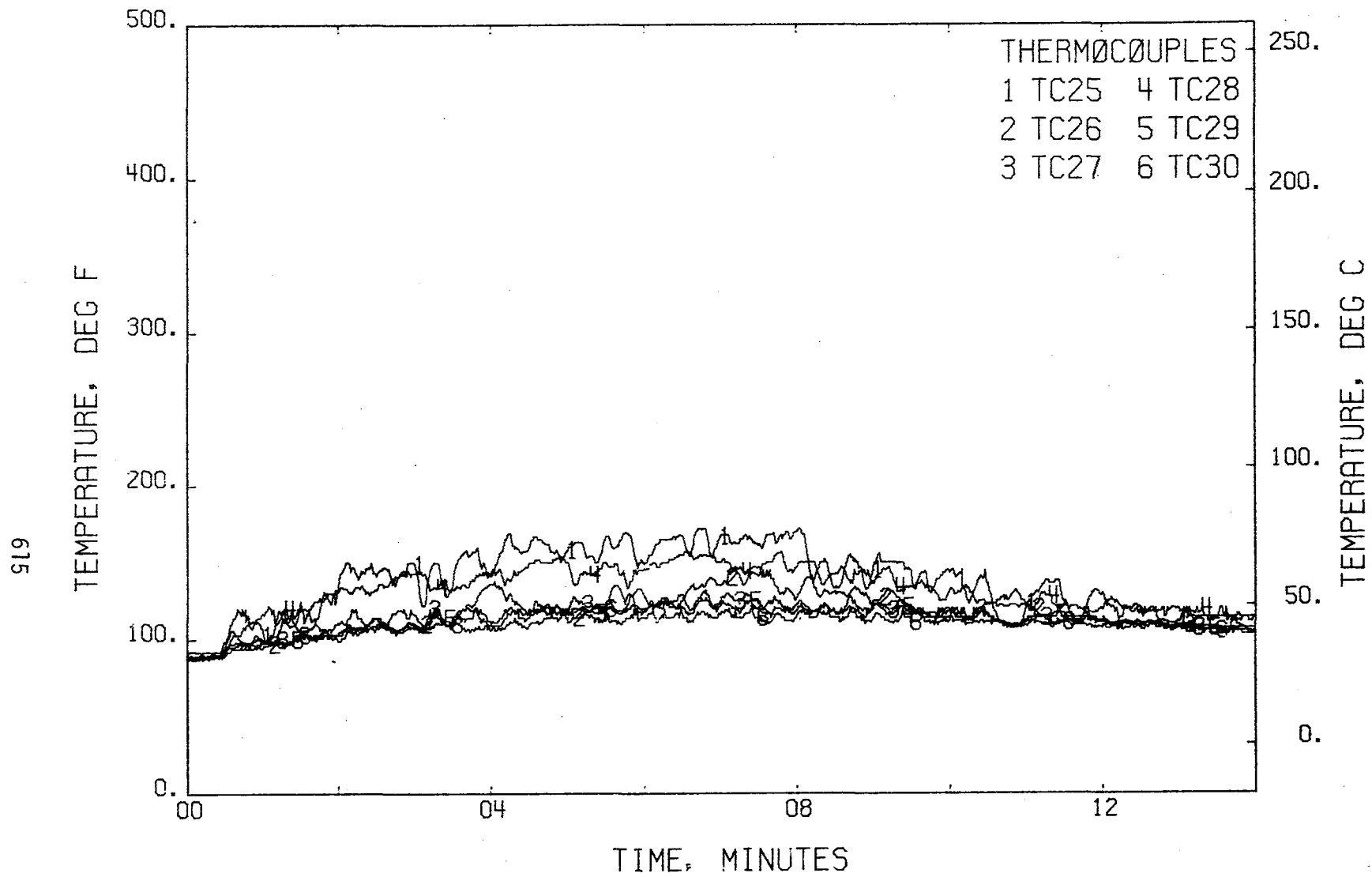


FIGURE 488 . - TEMPERATURES, T/C TREE 5  
TEST 22

919

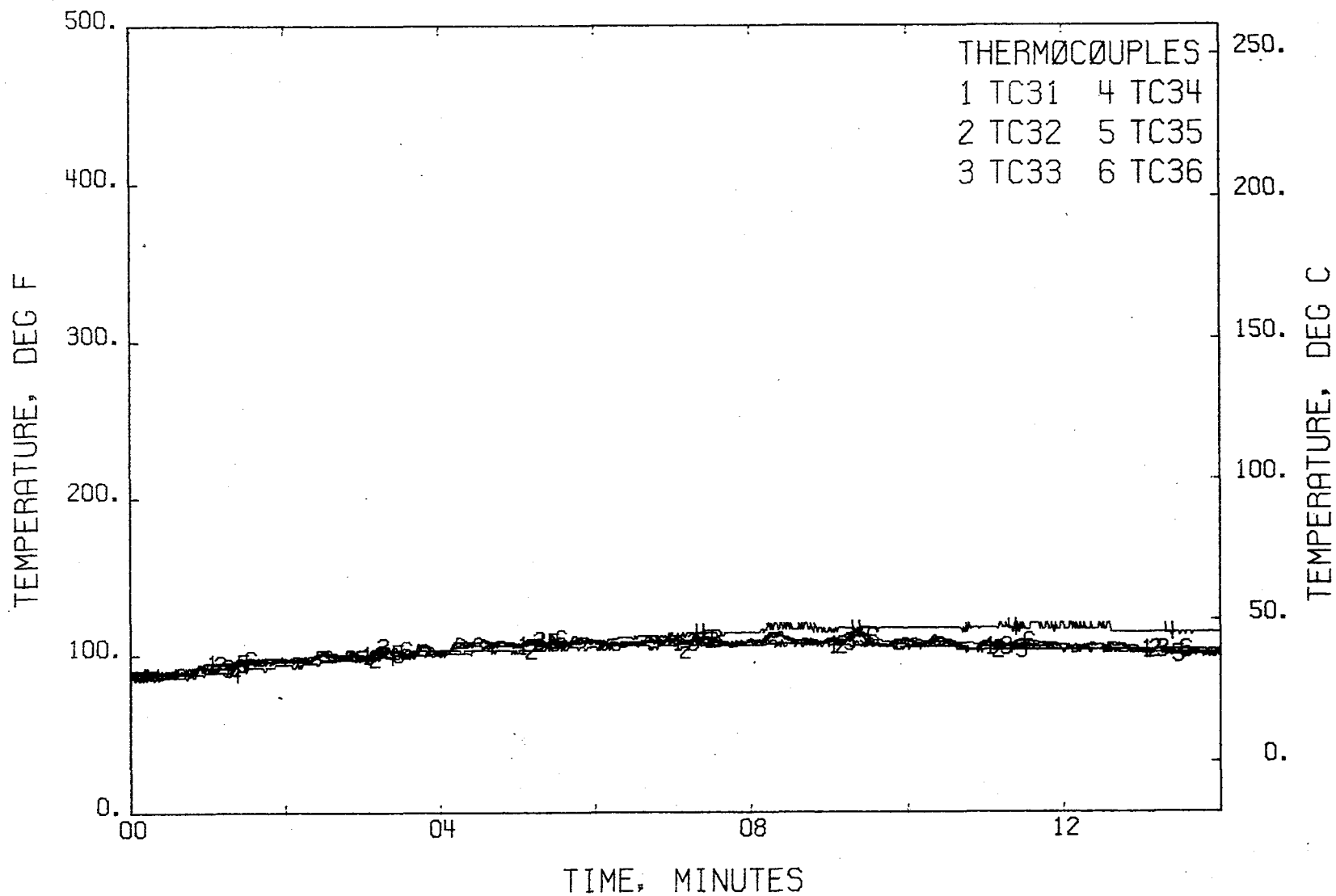


FIGURE 489 . - TEMPERATURES, T/C TREE 6  
 TEST 22



619

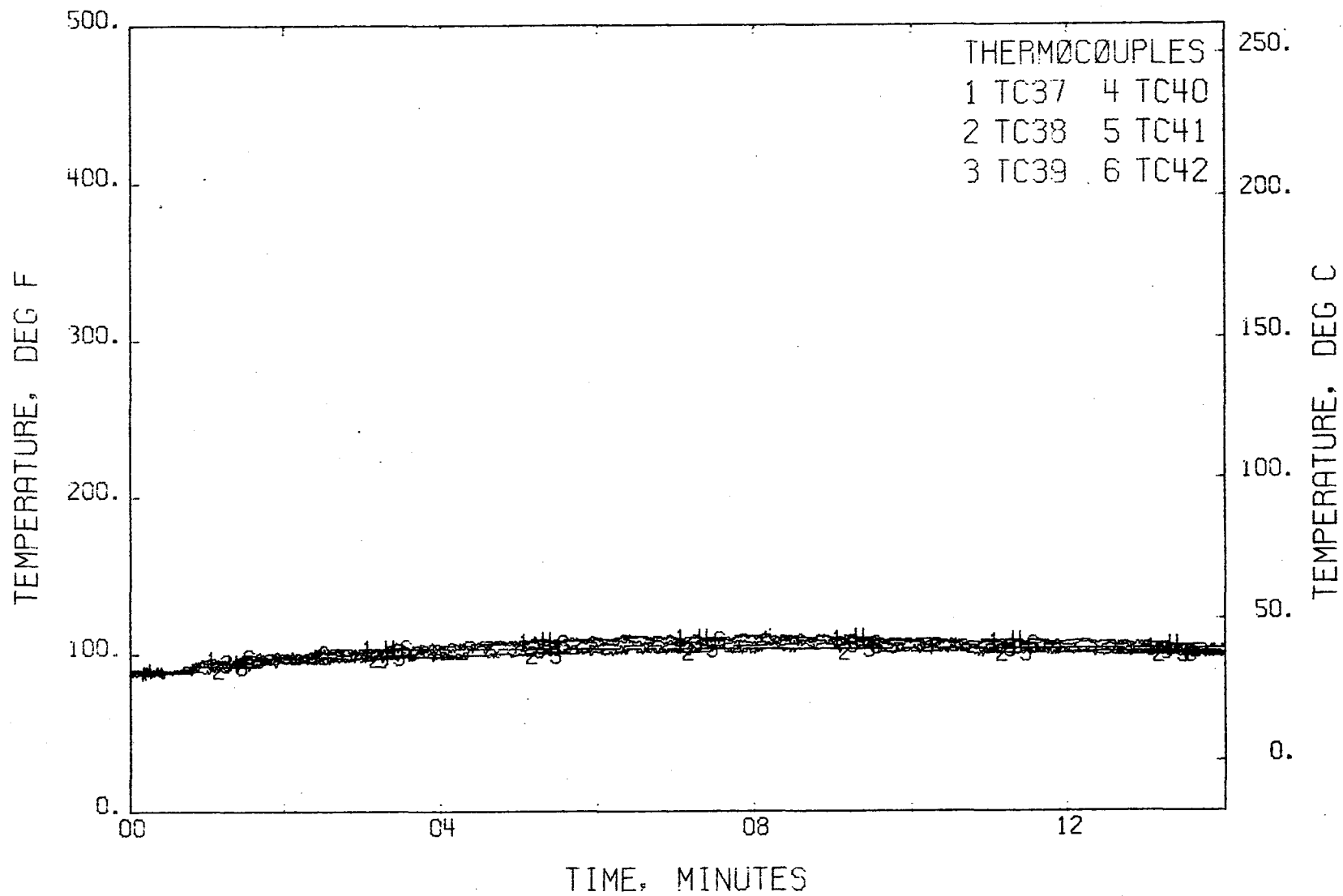


FIGURE 490 . - TEMPERATURES, T/C TREE 7  
TEST 22

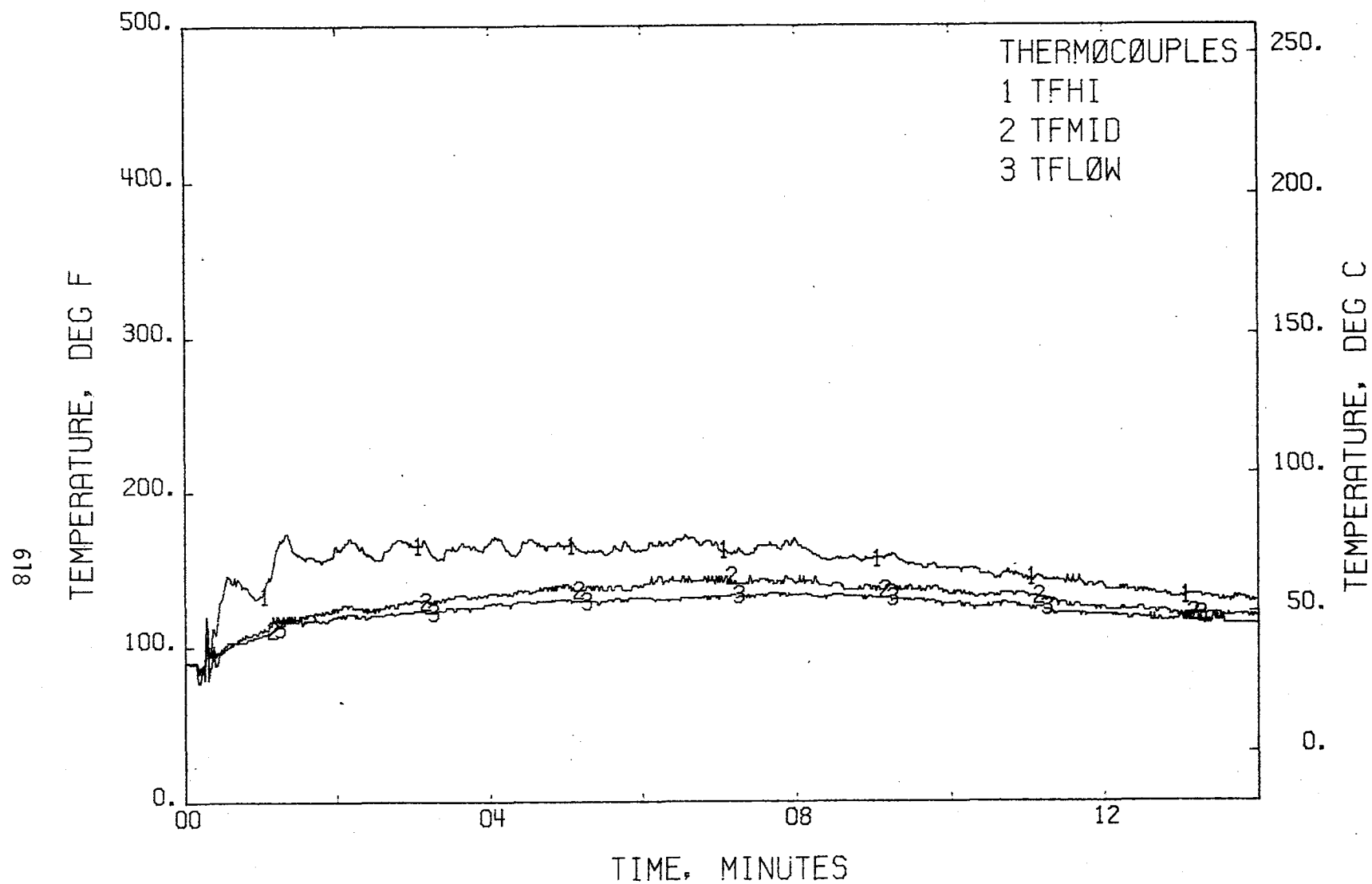


FIGURE 491 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 22

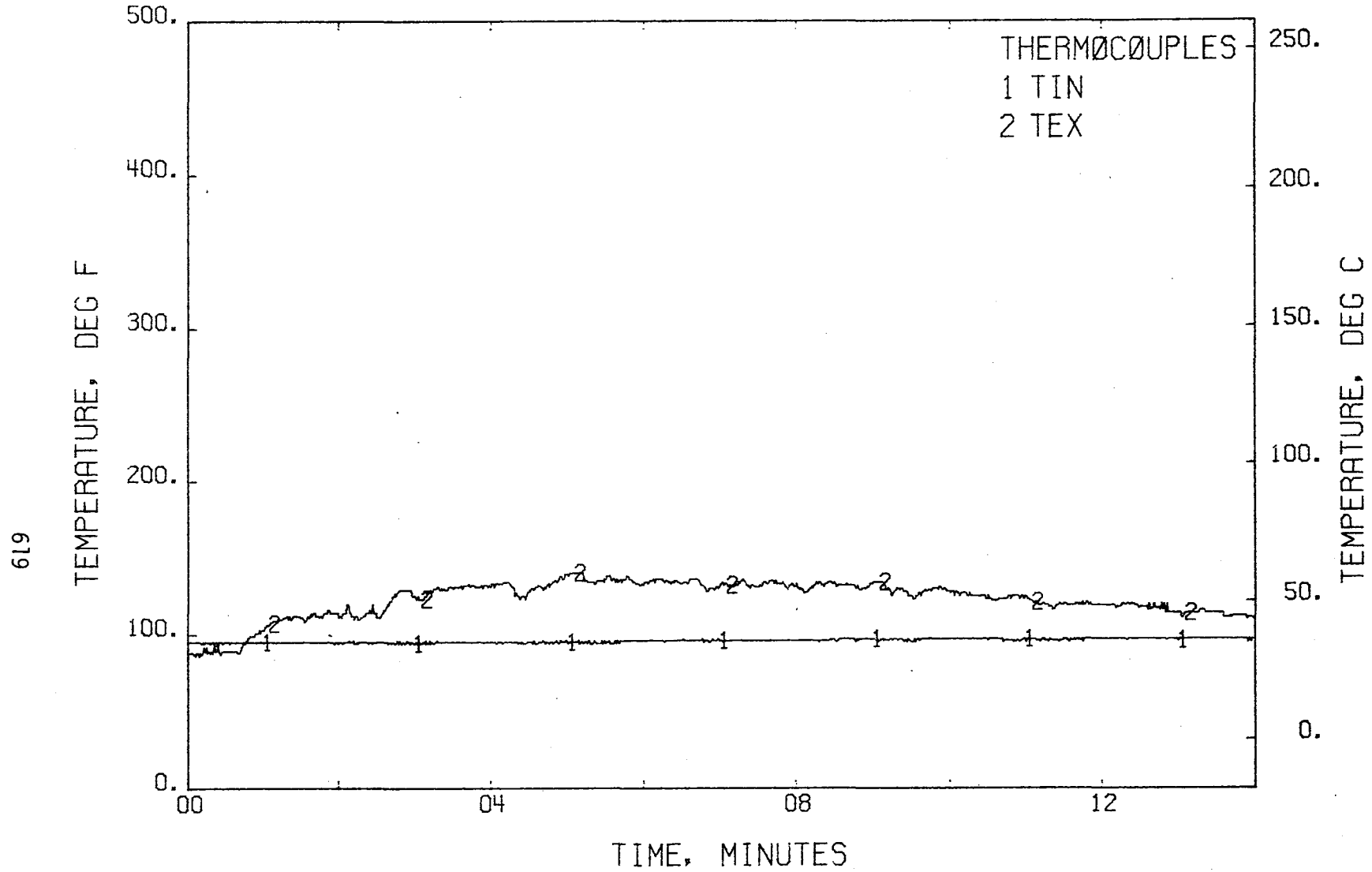


FIGURE 492 . - TEMPERATURES, INLET + EXIT  
TEST 22

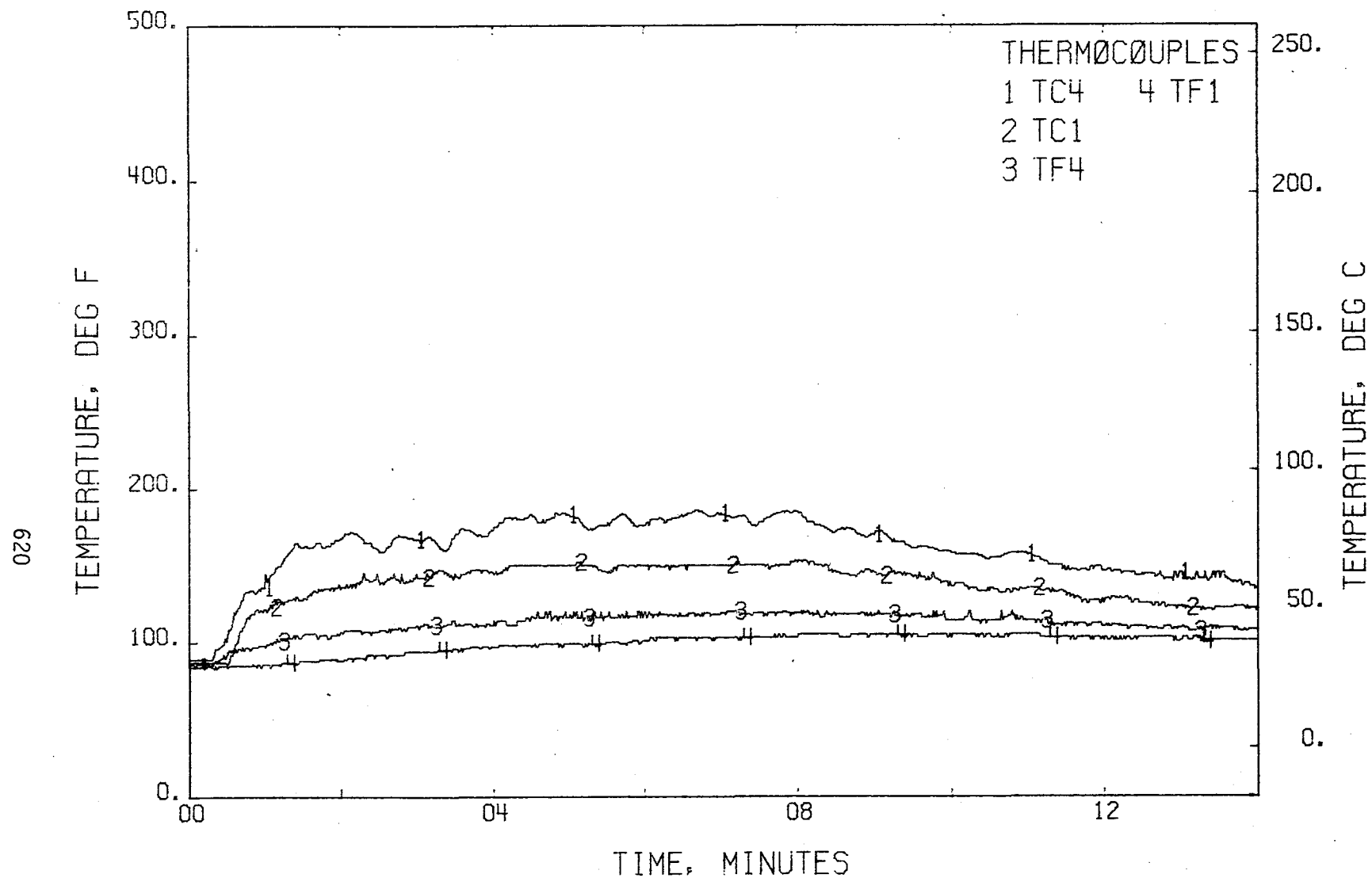


FIGURE 493 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 22

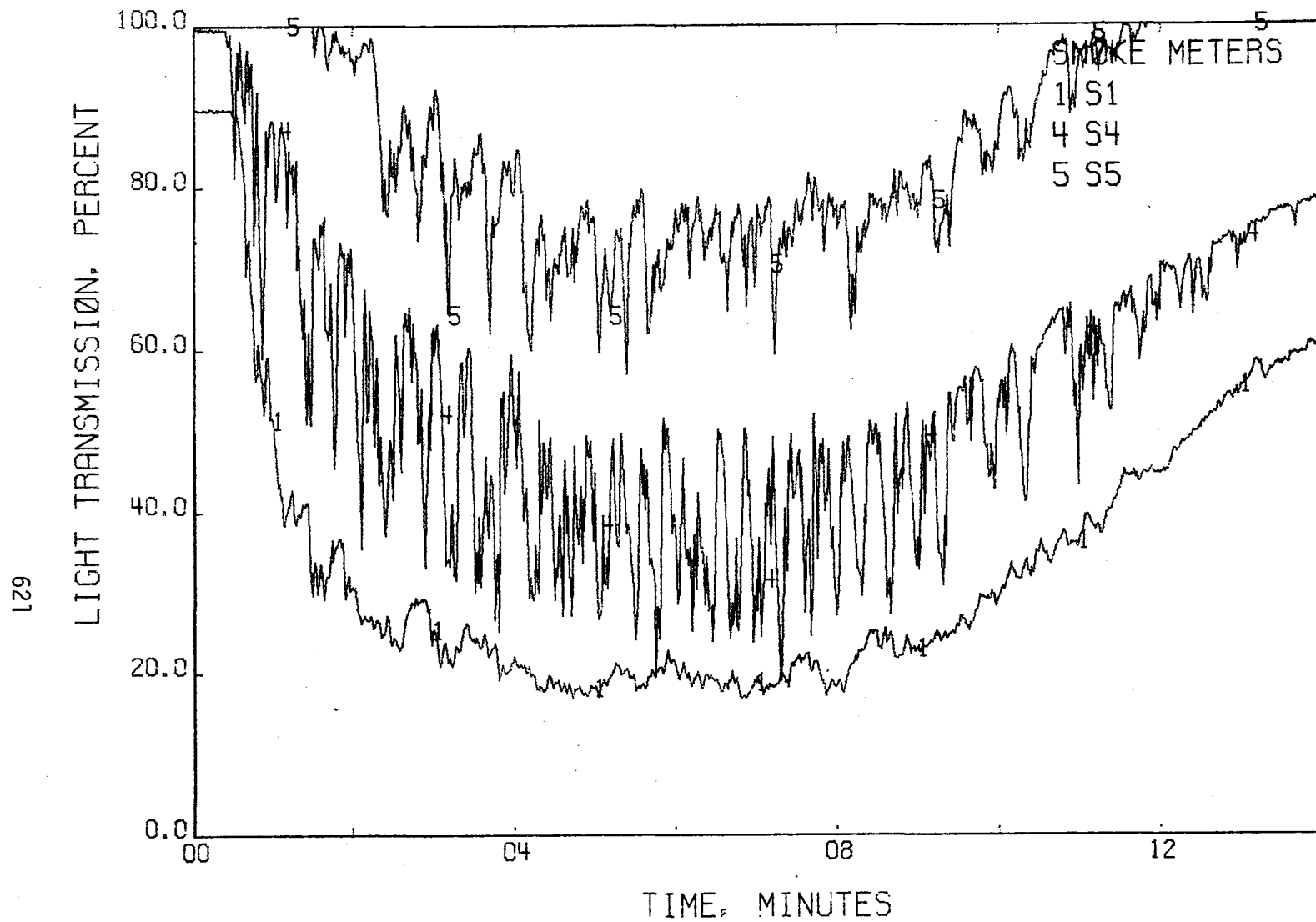


FIGURE 494 . - LIGHT TRANSMISSION  
TEST 22

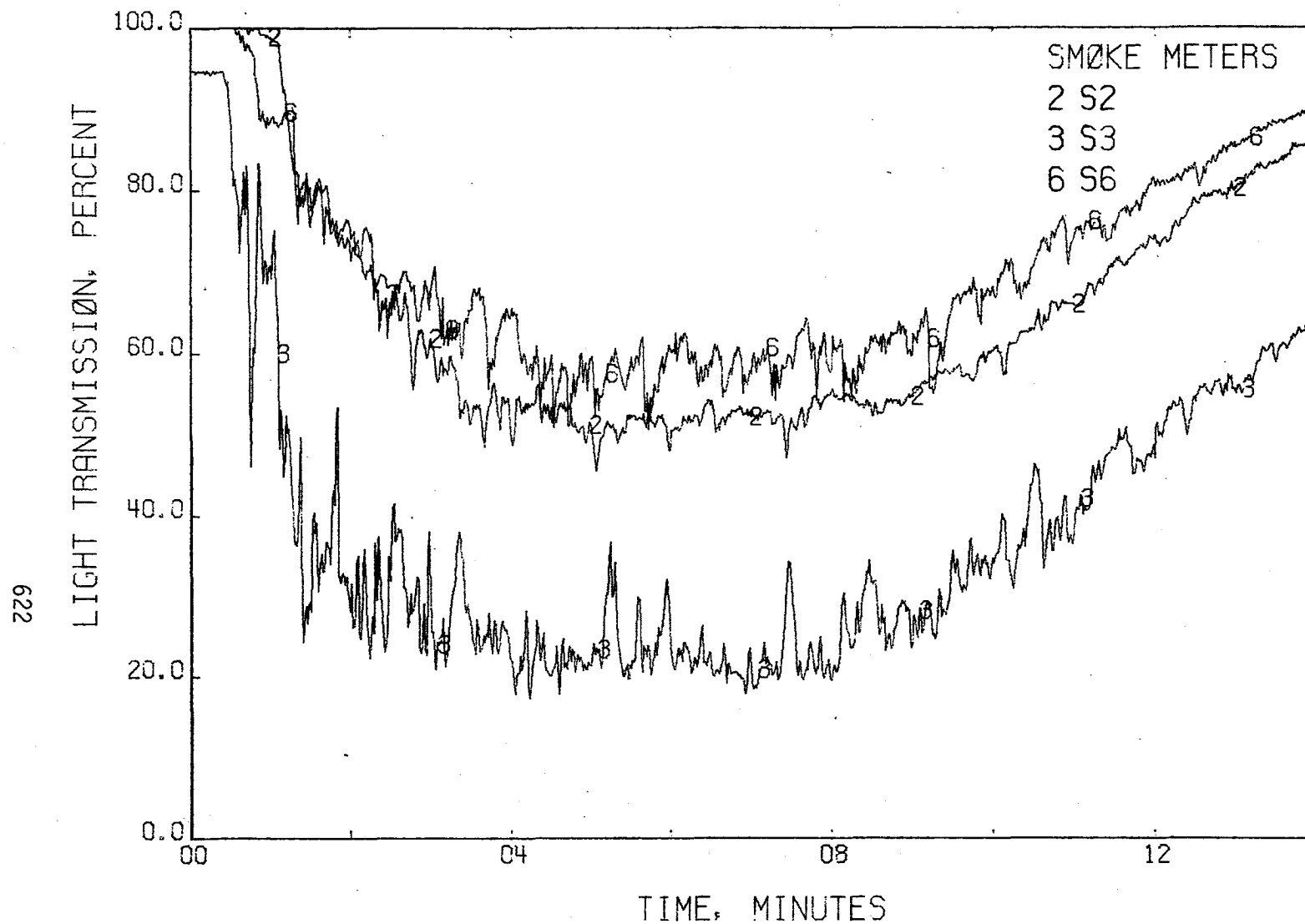


FIGURE 494 . - LIGHT TRANSMISSION - CONT.  
TEST 22

623

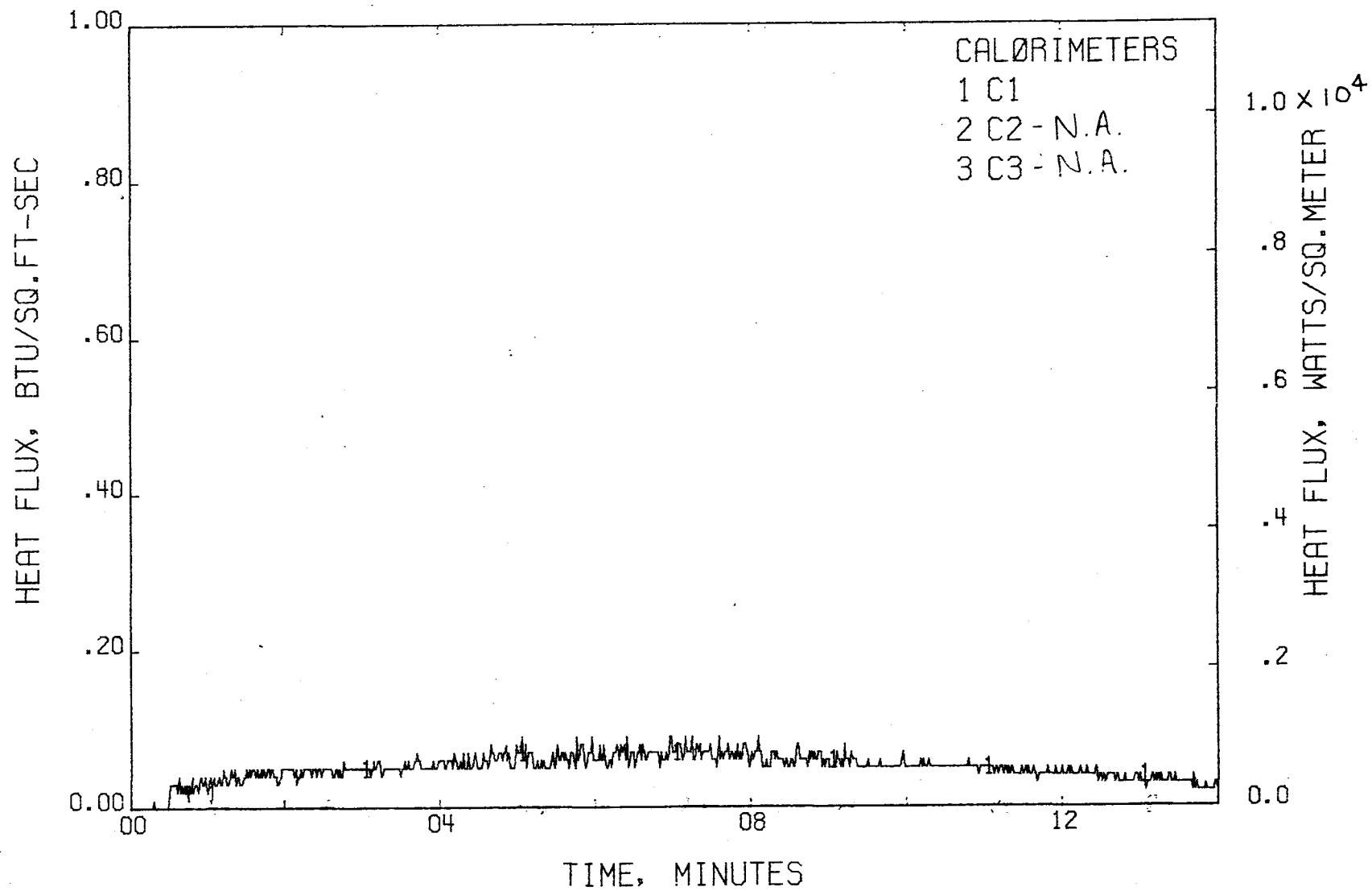
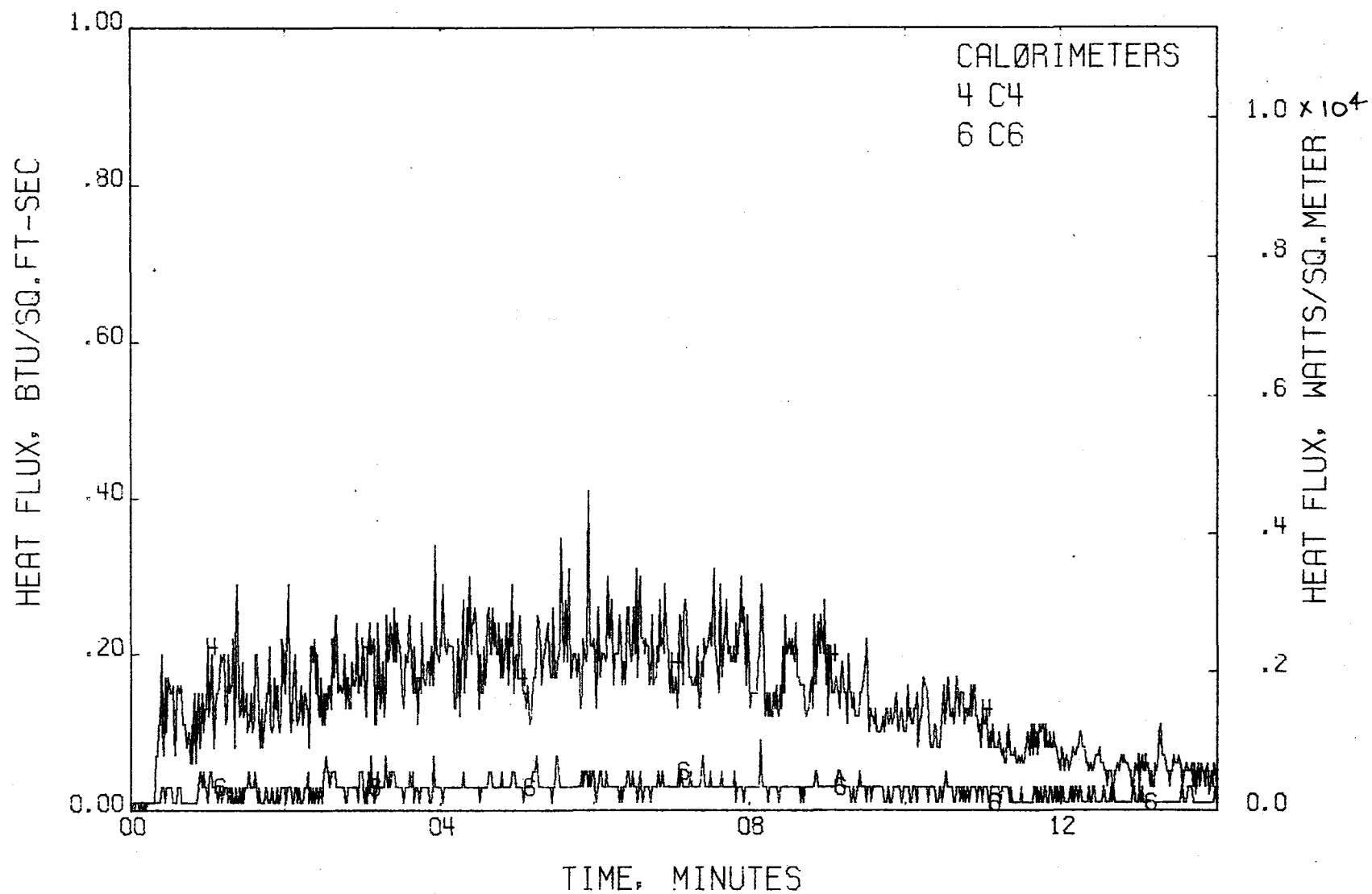


FIGURE 495 . - HEAT FLUX, AFT  
TEST 22

624





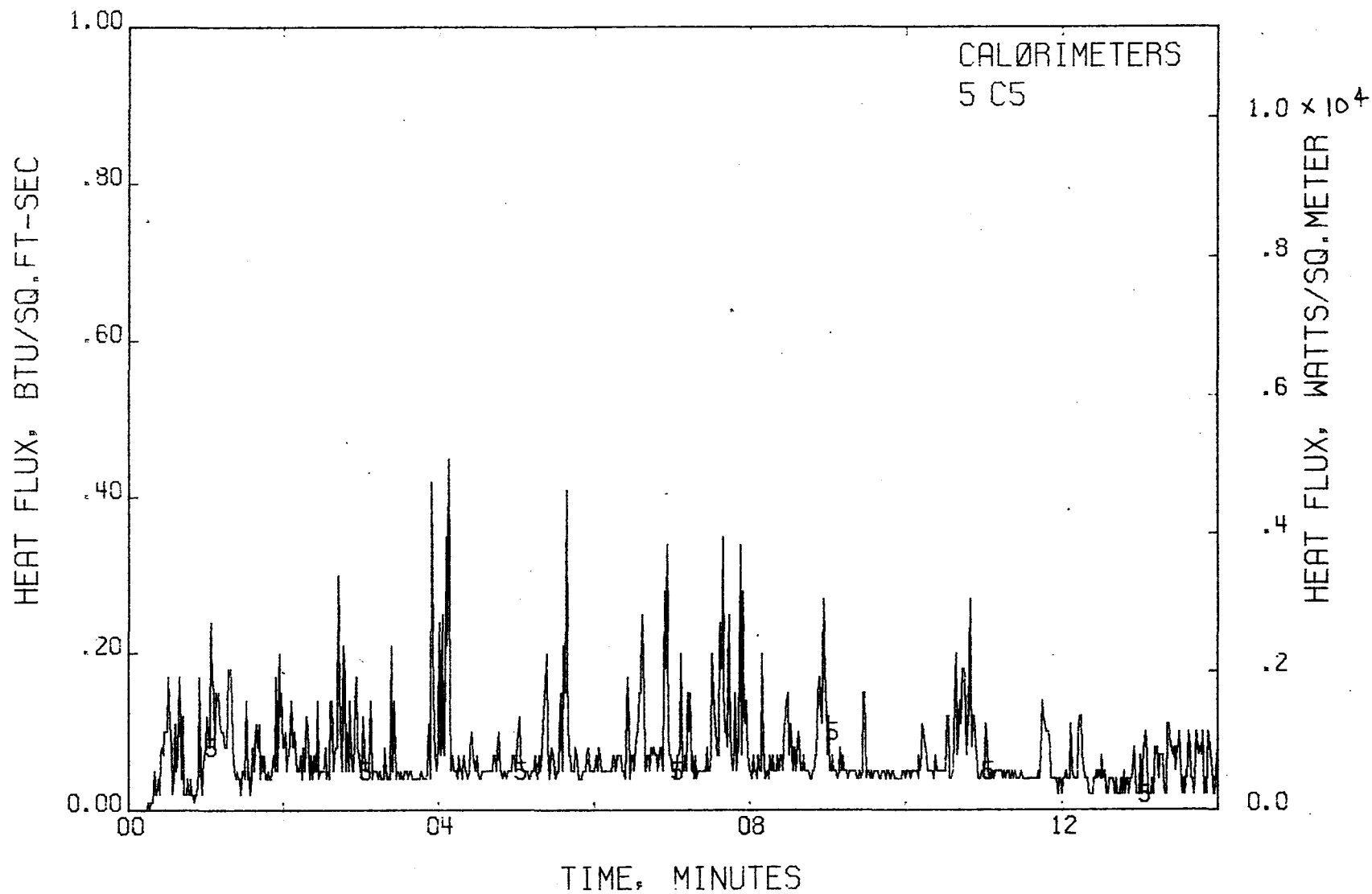


FIGURE 496 . - HEAT FLUX, MIDSECTION - CONT.  
TEST 22

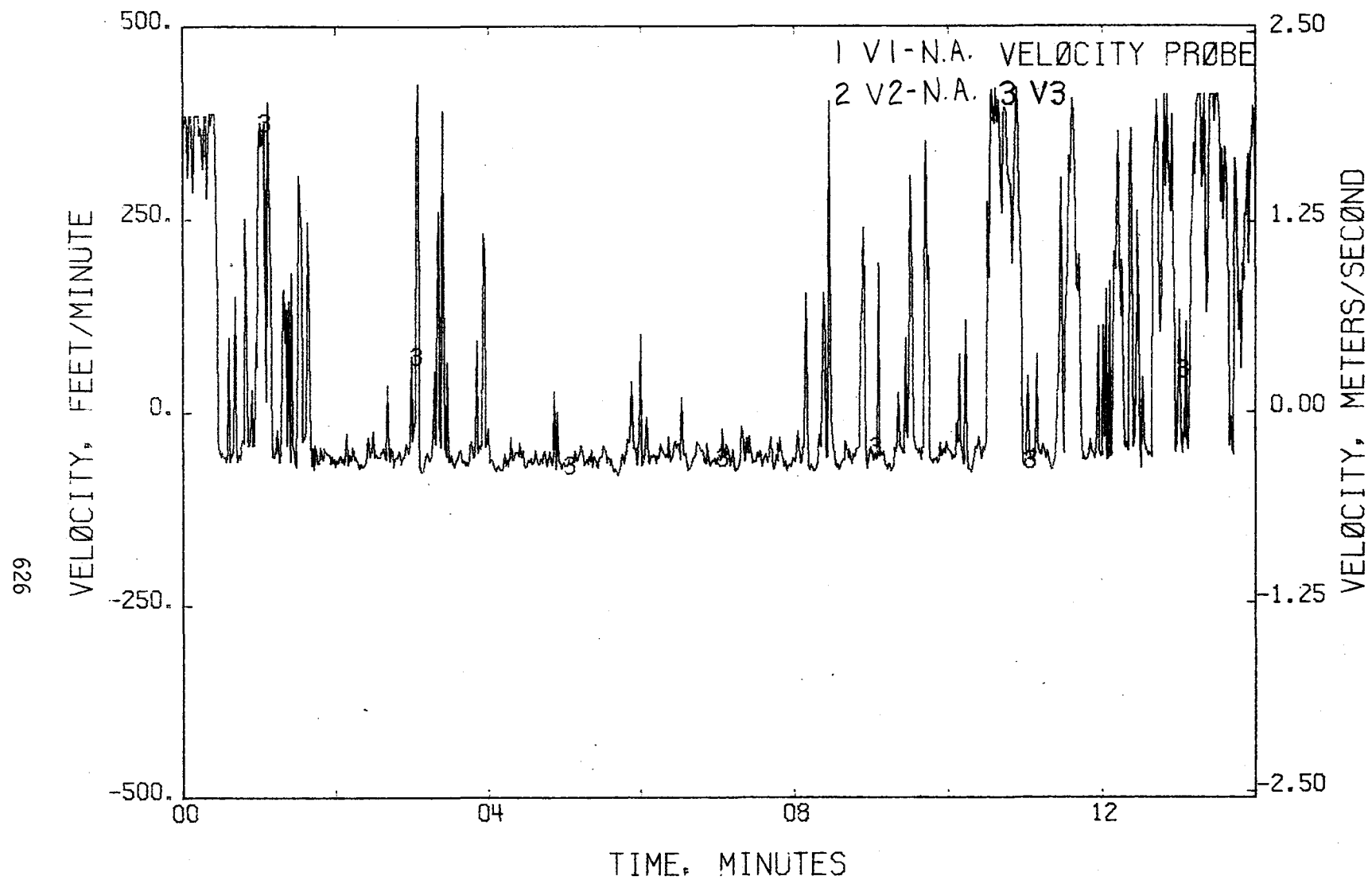


FIGURE 497 . - AIR VELOCITY  
TEST 22

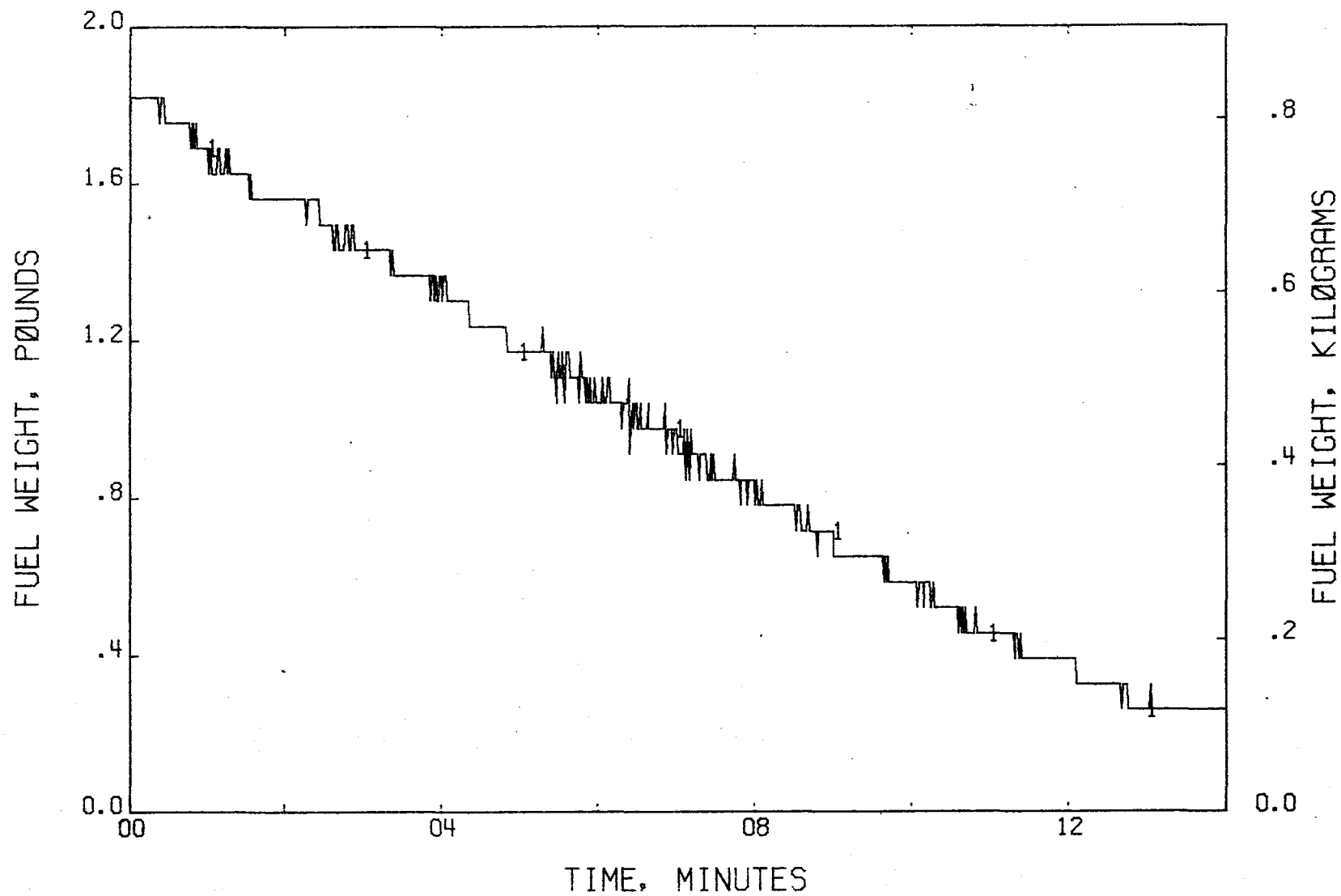


FIGURE 498 . - FUEL WEIGHT LOSS  
TEST 22

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 3 PPM

HYDROGEN FLUORIDE - < 3 PPM

HYDROGEN CHLORIDE - < 6 PPM

DUE TO EQUIPMENT PROBLEMS, THE CONCENTRATIONS OF  
THE FOLLOWING NON-HYDROLYZABLE GASES WERE NOT  
OBTAINED IN THIS TEST:

---

- o CARBON MONOXIDE
- o HYDROCARBONS

CARBON MONOXIDE AND HYDROCARBONS  
CONCENTRATIONS

TEST 22

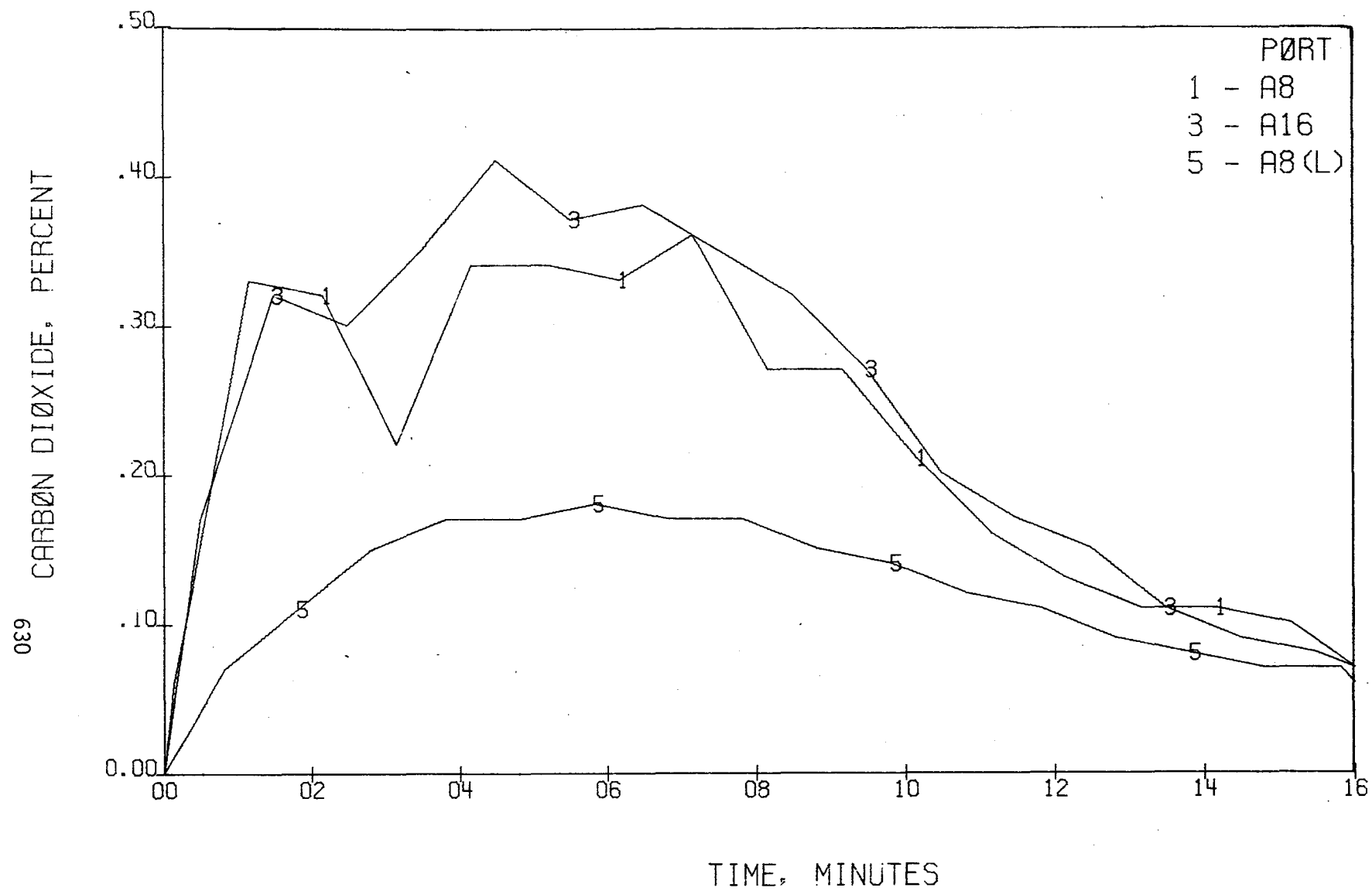


FIGURE 500 . - CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 22

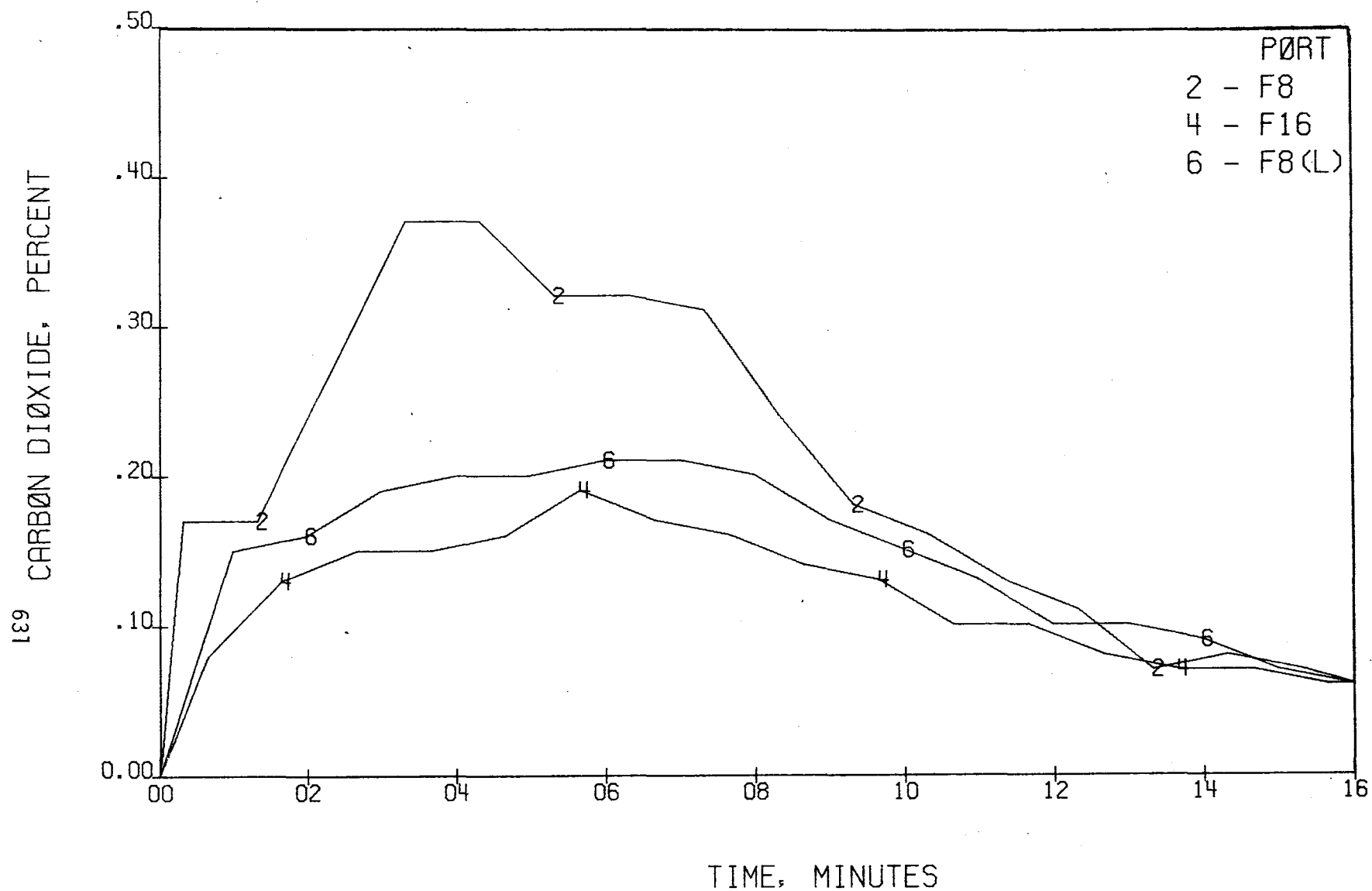


FIGURE 501.- CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 22

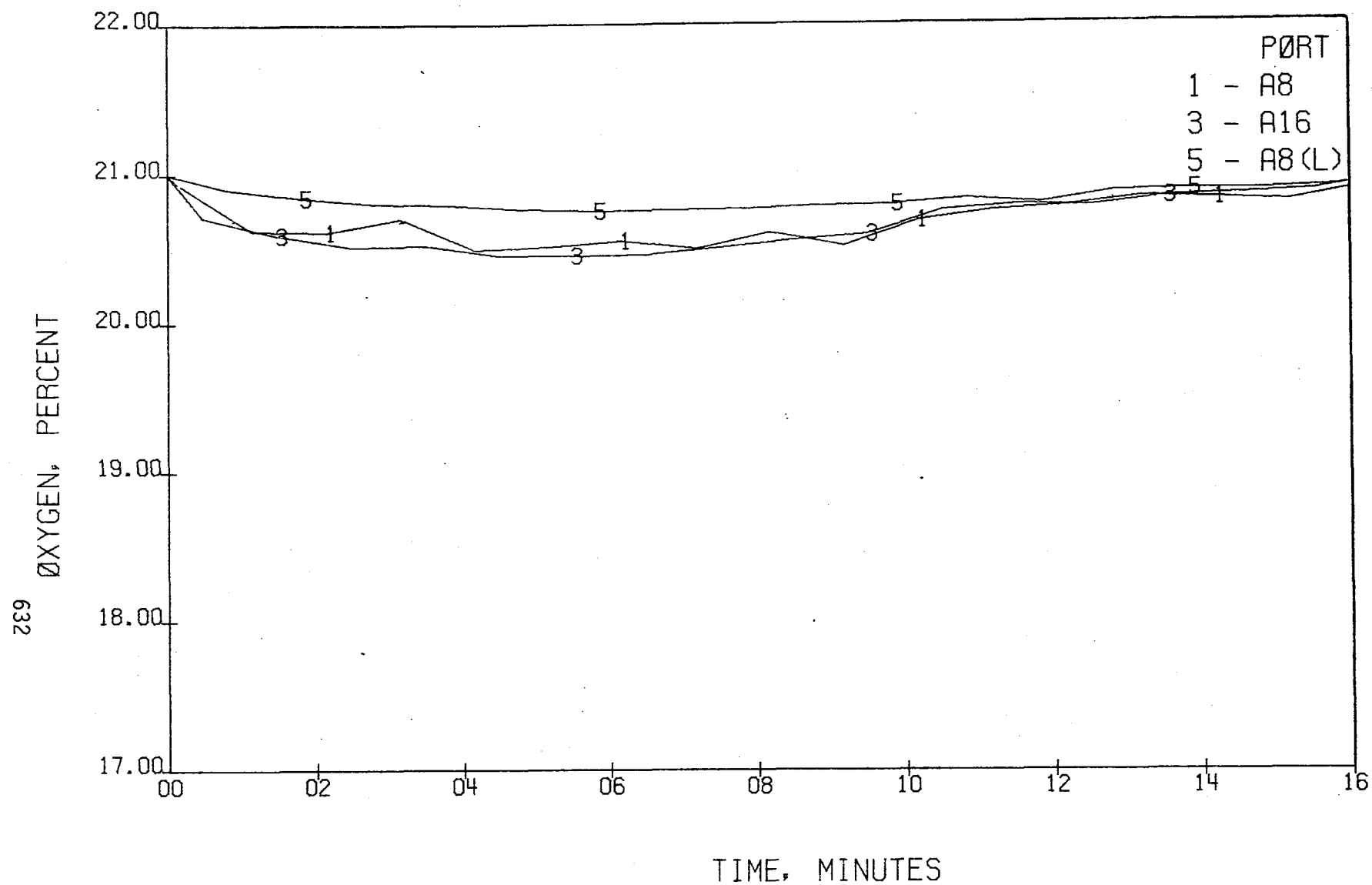


FIGURE 502 . - ØXYGEN CØNCENTRATIONS , AFT  
TEST 22



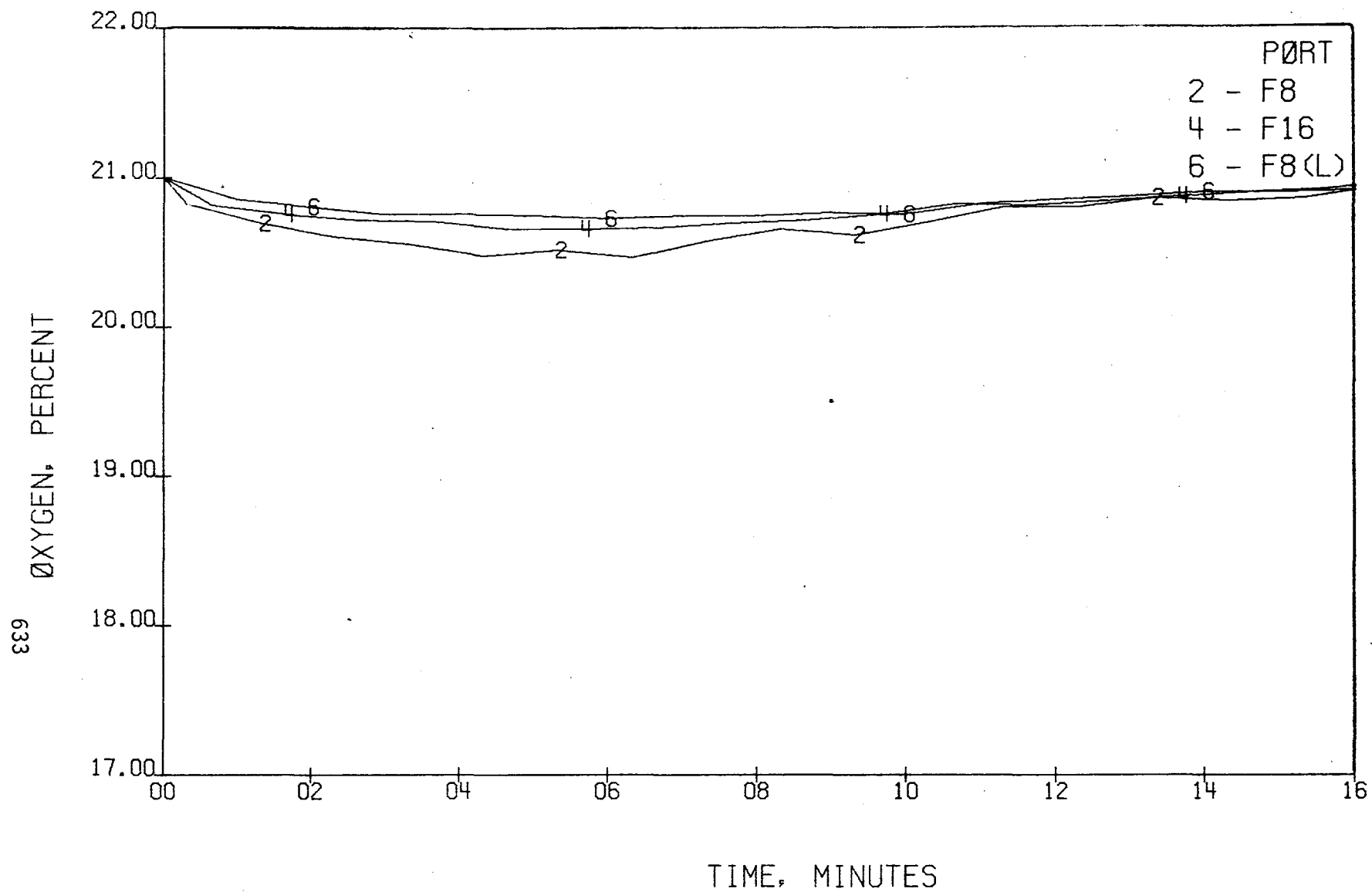


FIGURE 503 . - ØXYGEN CØNCENTRATIONS, FØRE  
TEST 22



TEST 23

---

WALL, PSU, BIN, AND CEILING PANELS

## TEST 23

### WALL, PSU, BIN, AND CEILING PANELS

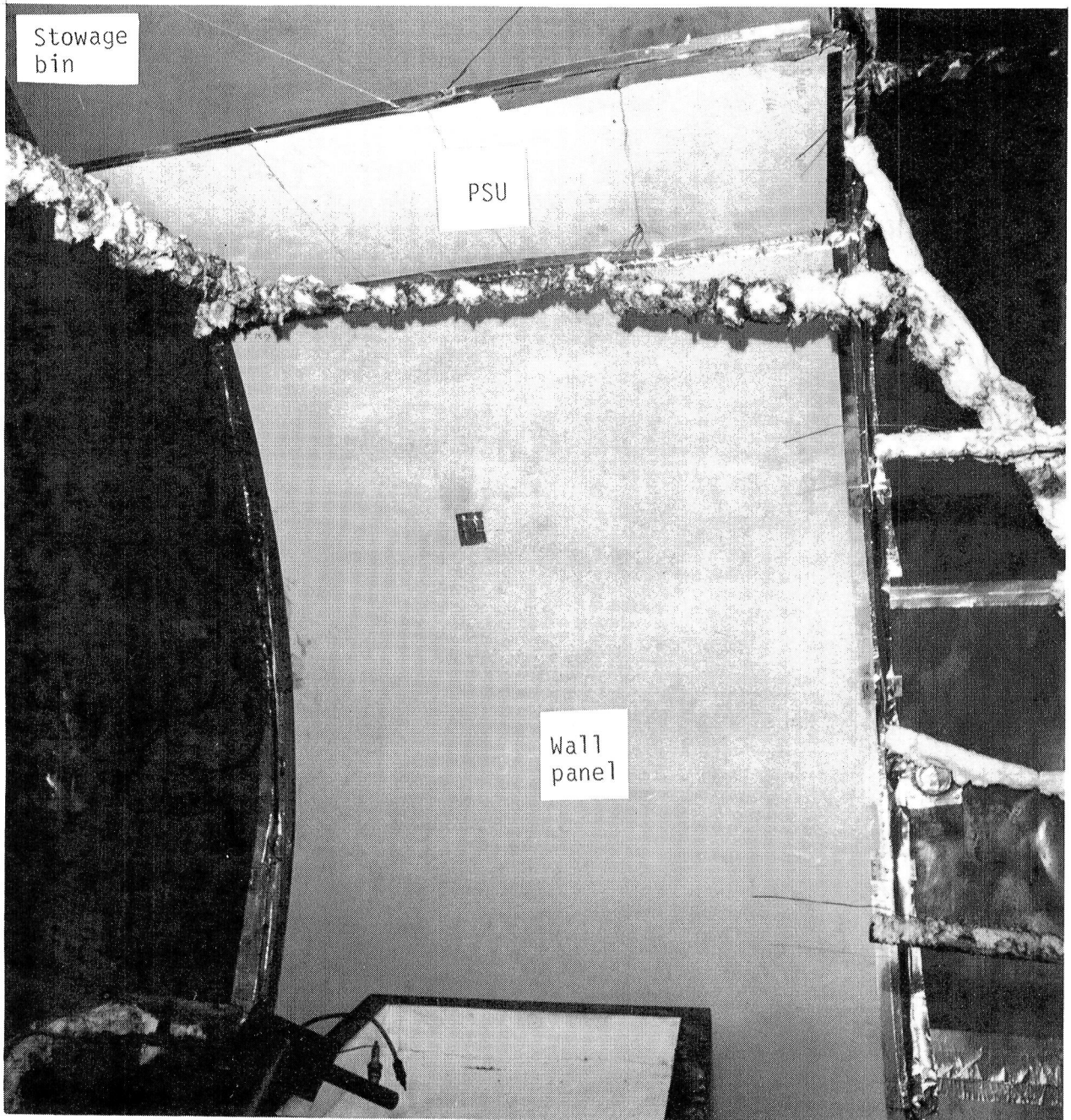


FIGURE 504. - PRE-TEST CONFIGURATION, TEST 23

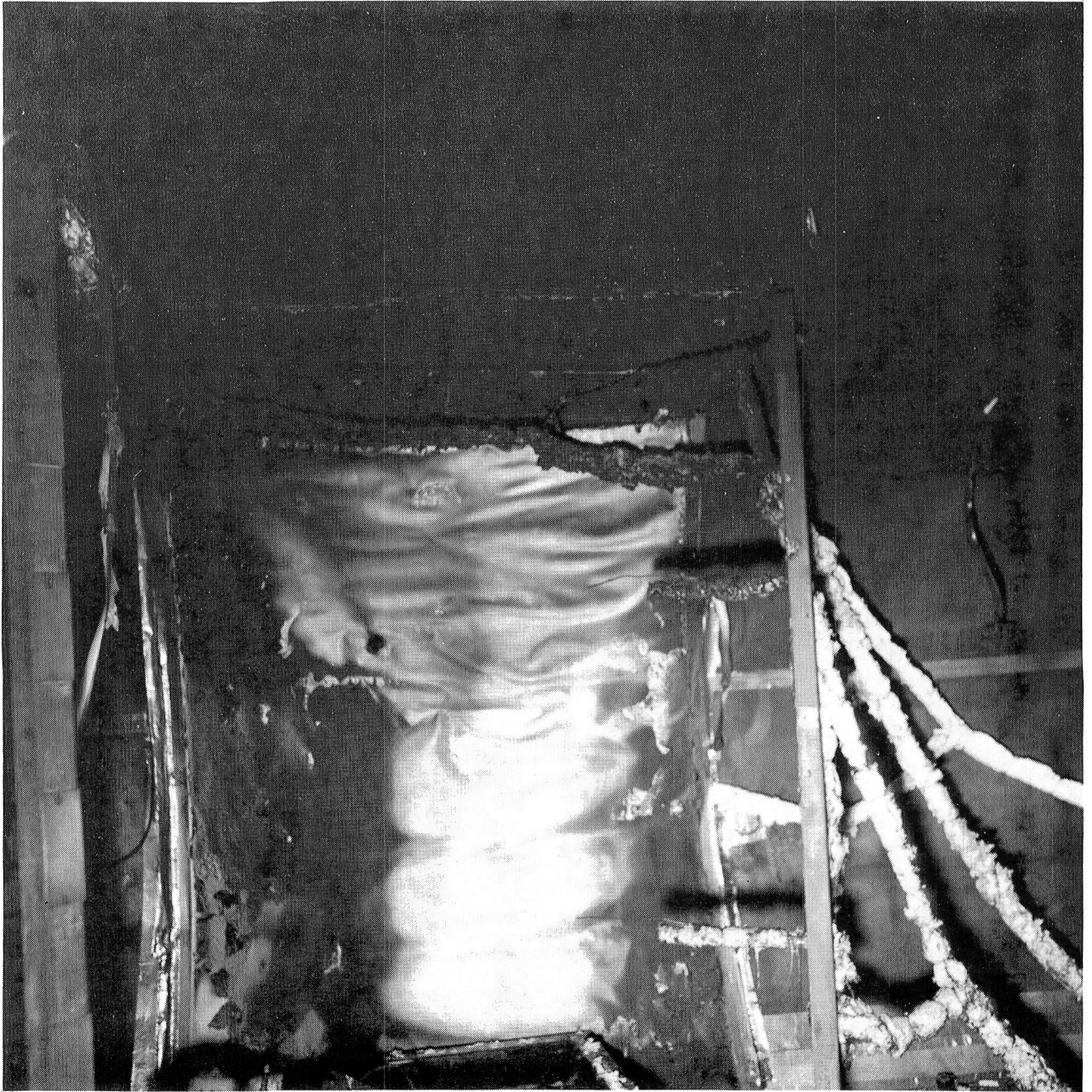


FIGURE 505 . - POST-TEST CONFIGURATION, TEST 23





FIGURE 506 . - FIRE DURING TEST 23

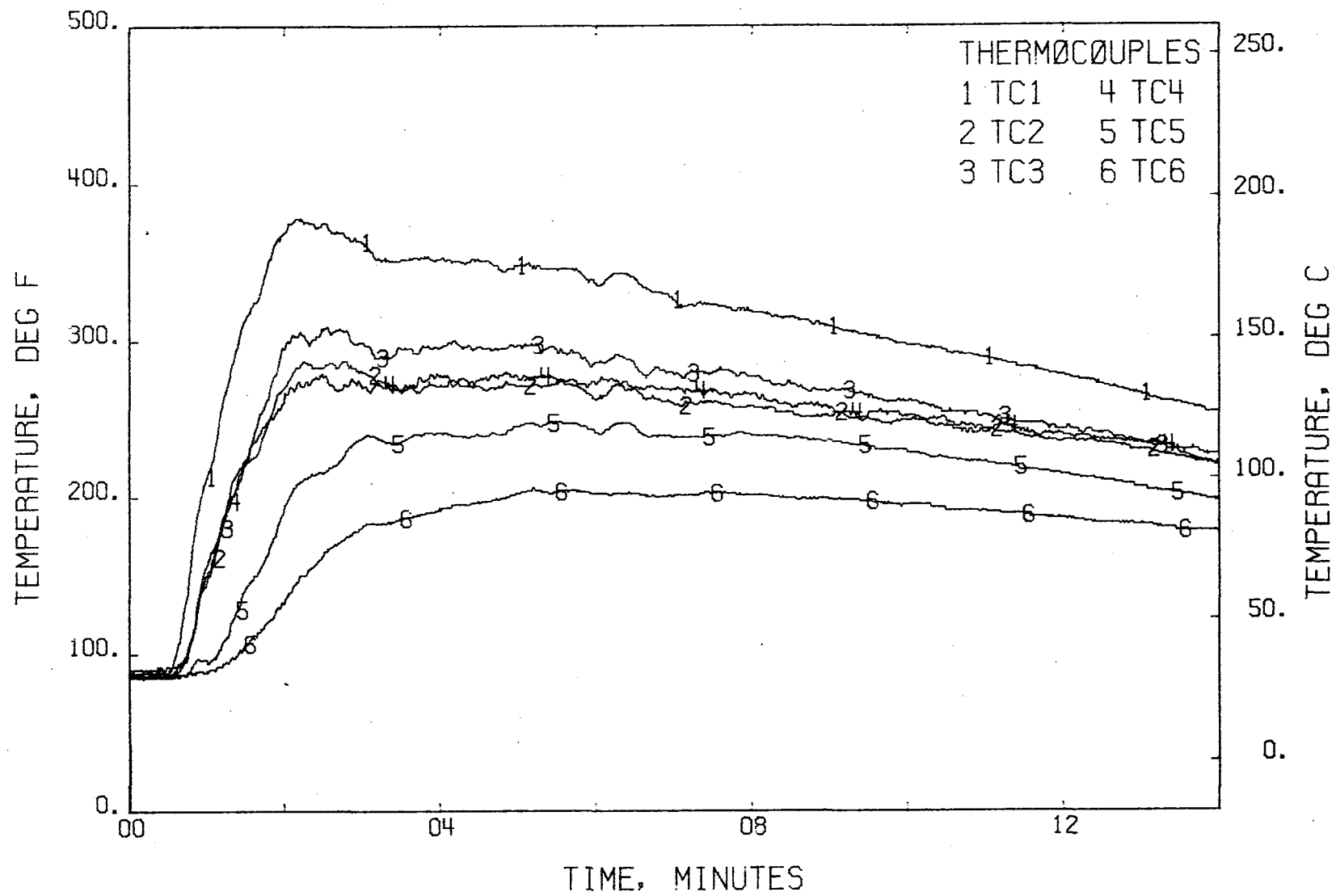


FIGURE 507 . - TEMPERATURES, T/C TREE 1  
TEST 23

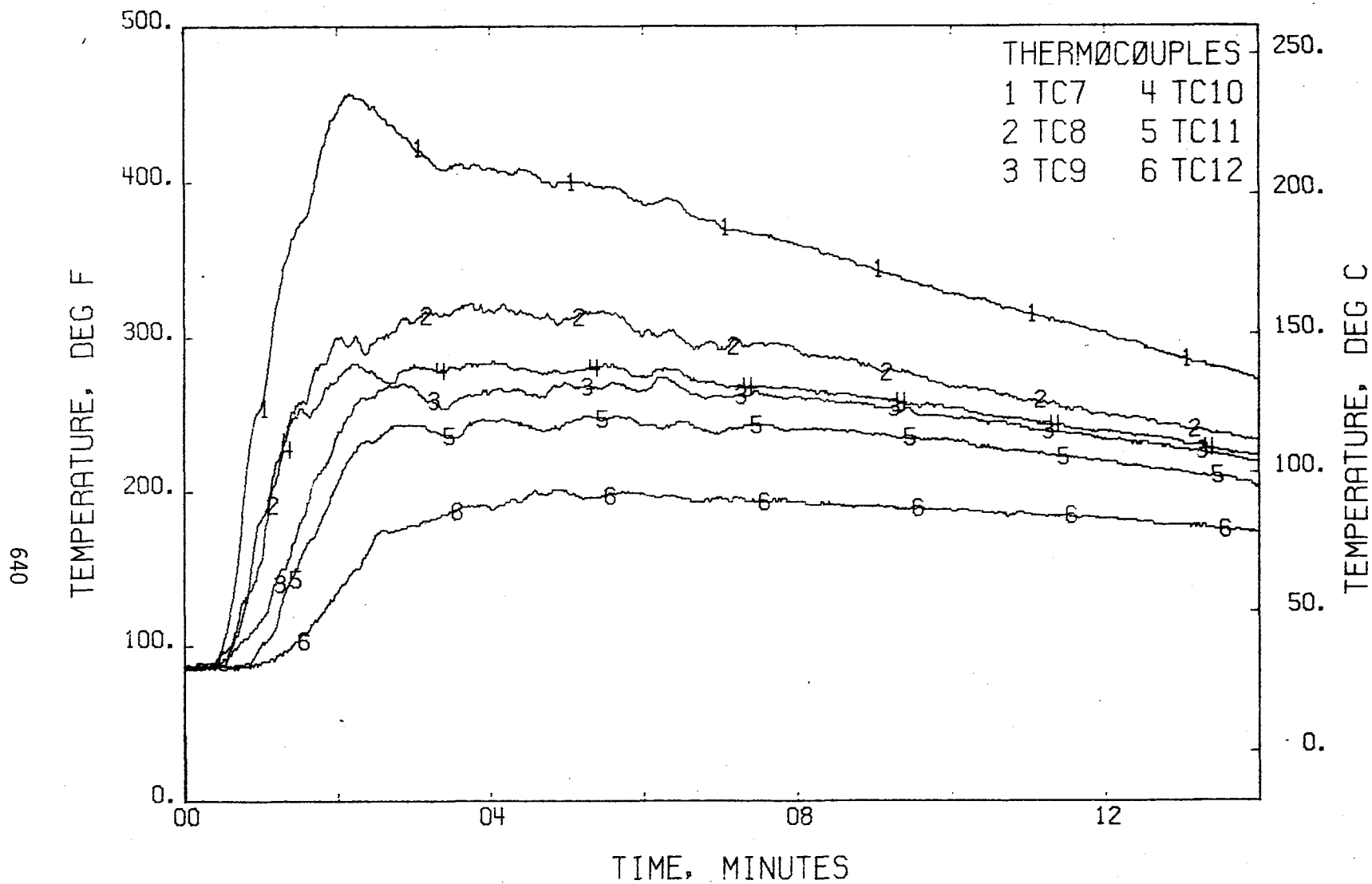


FIGURE 508 . - TEMPERATURES, T/C TREE 2  
TEST 23



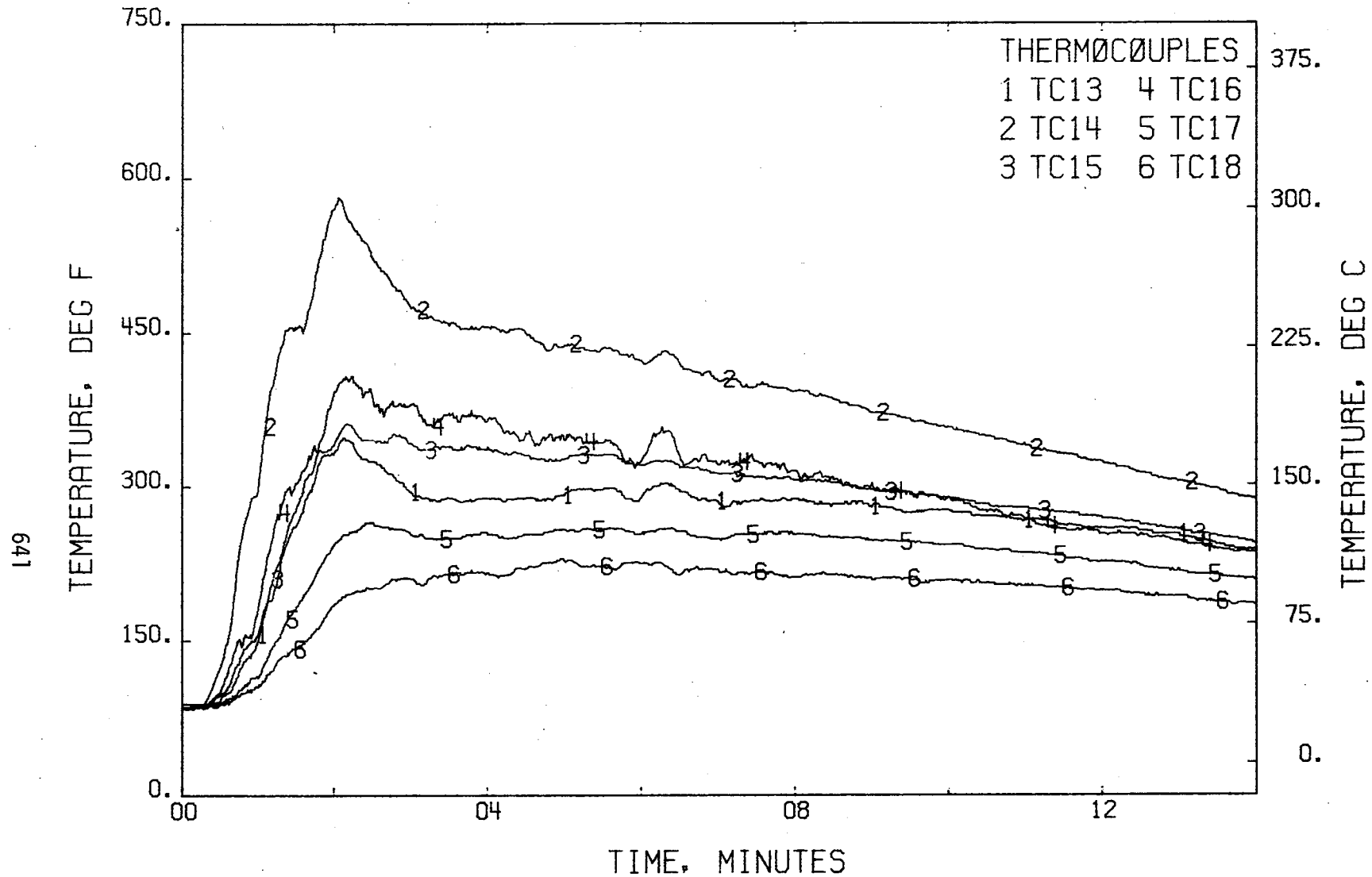


FIGURE 509 . - TEMPERATURES, T/C TREE 3  
TEST 23

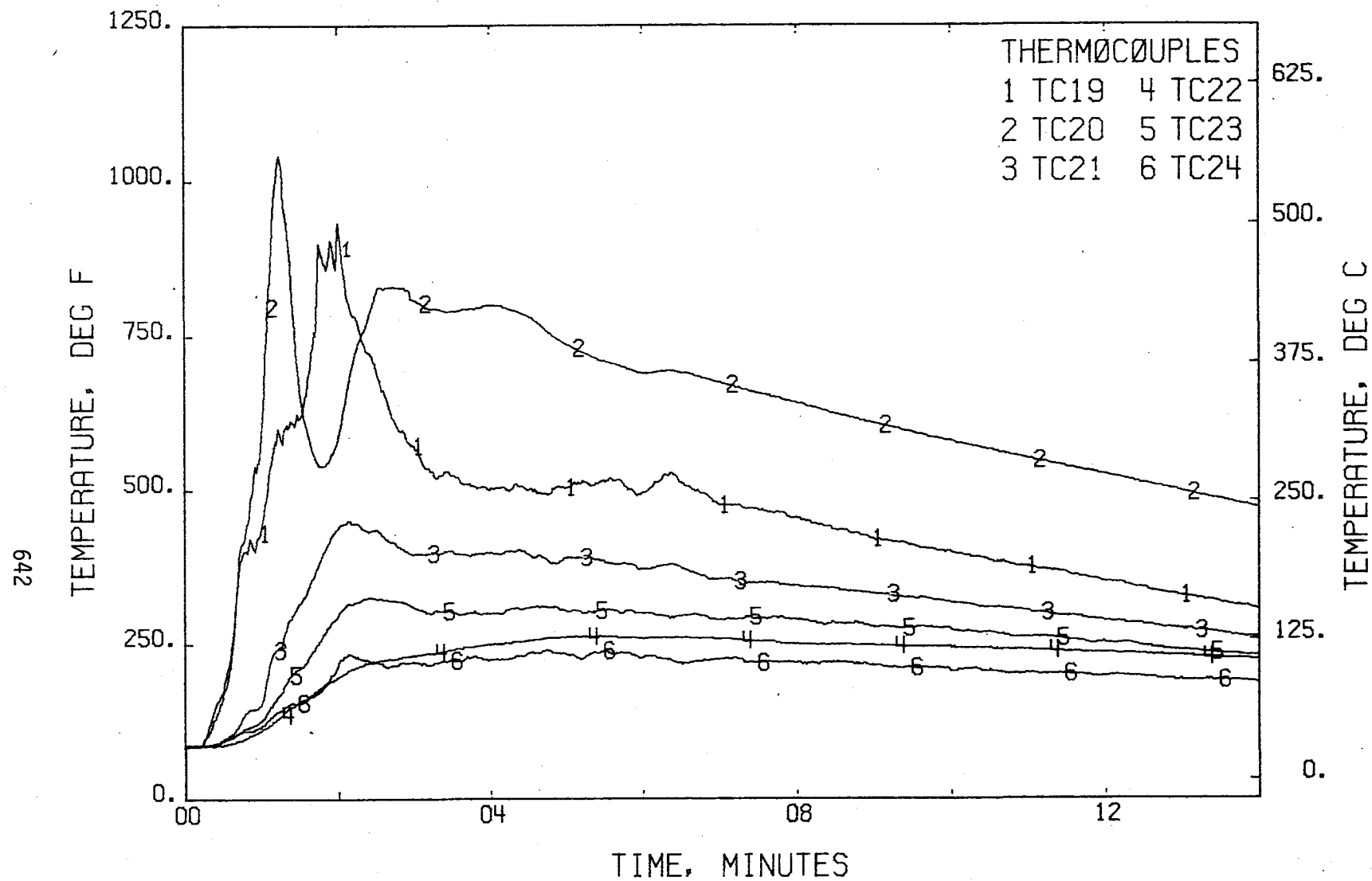


FIGURE 510 . - TEMPERATURES, T/C TREE 4  
TEST 23

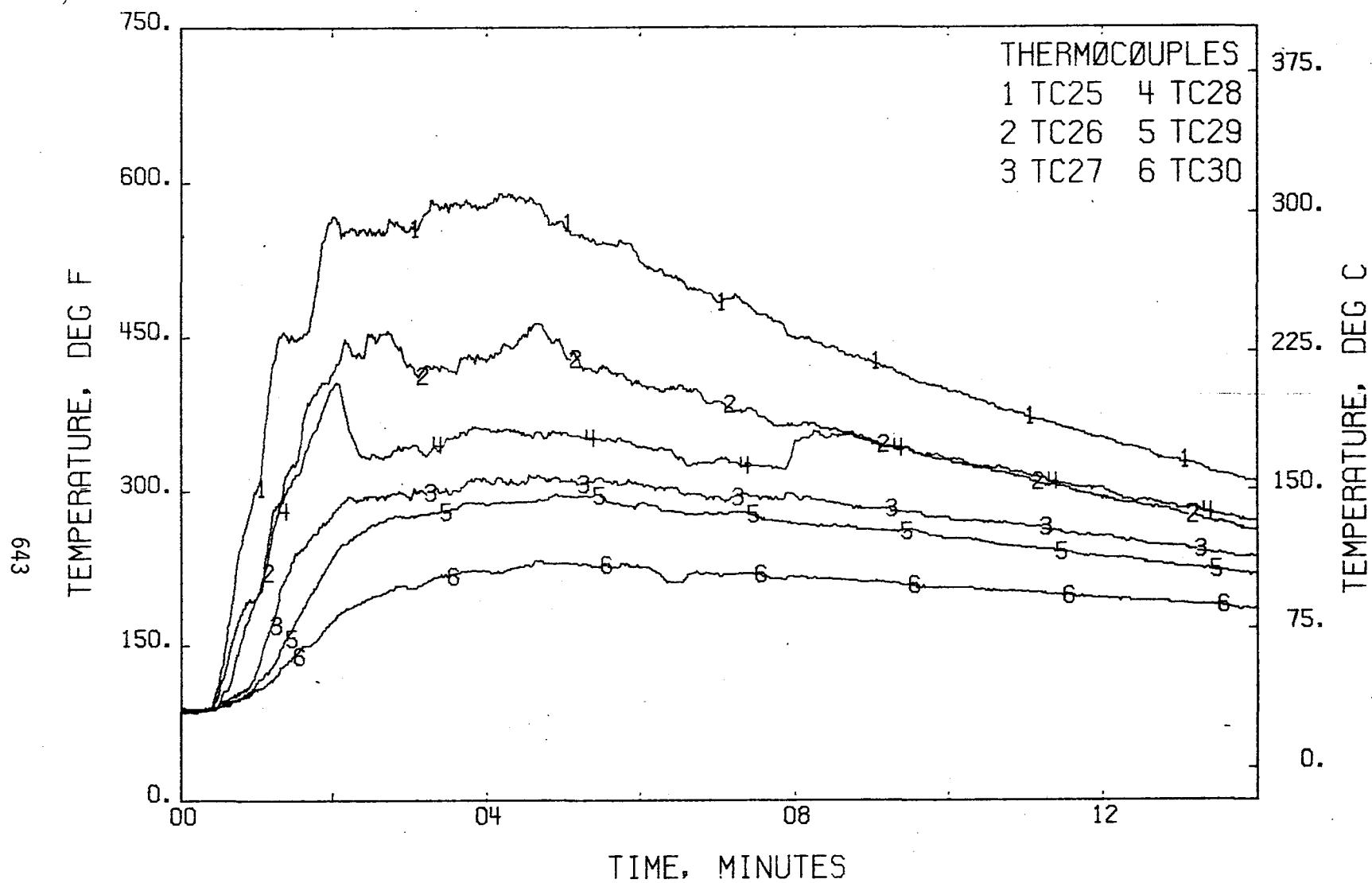


FIGURE 511 . - TEMPERATURES, T/C TREE 5  
TEST 23

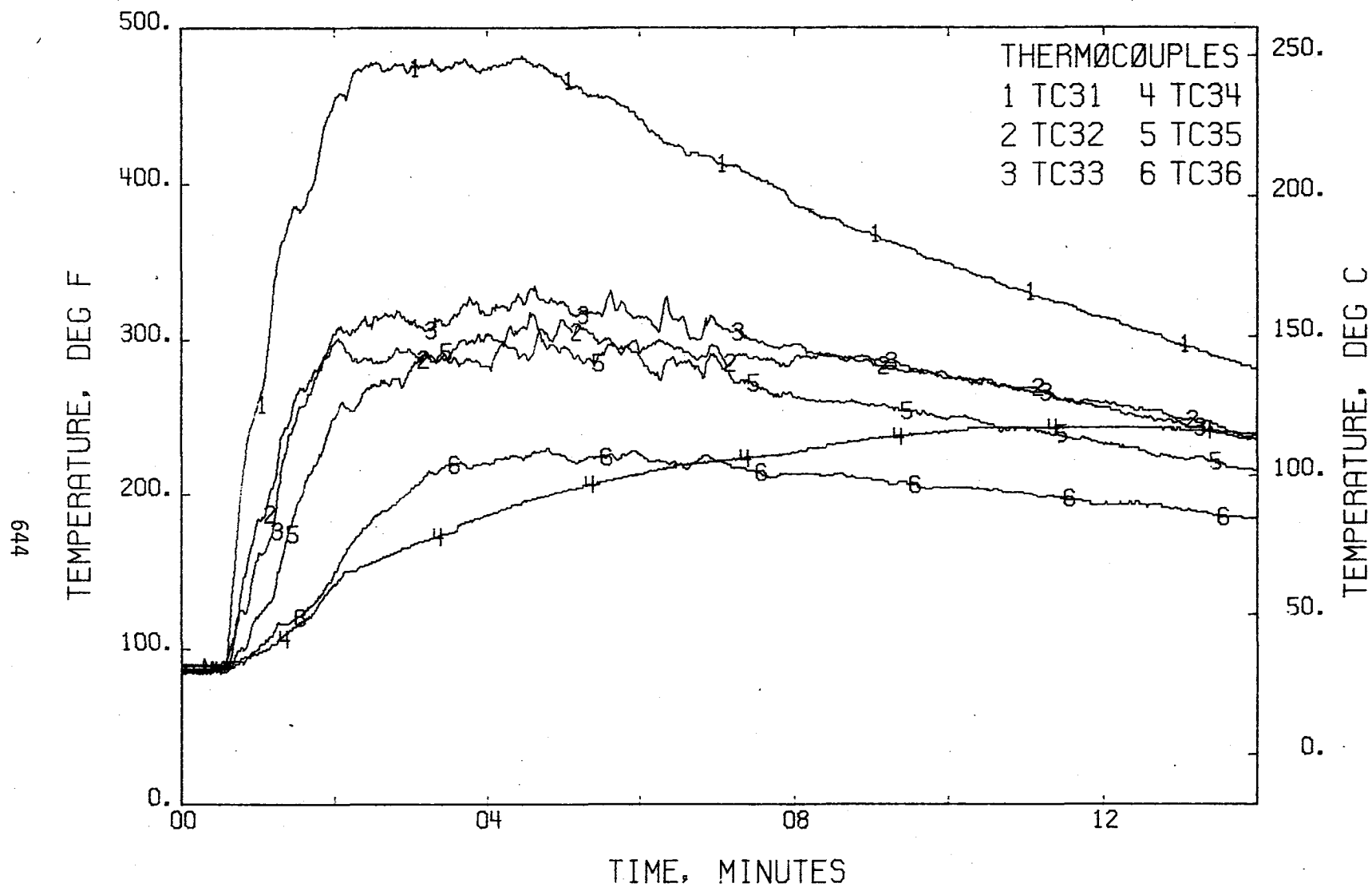


FIGURE 512 . - TEMPERATURES, T/C TREE 6  
TEST 23

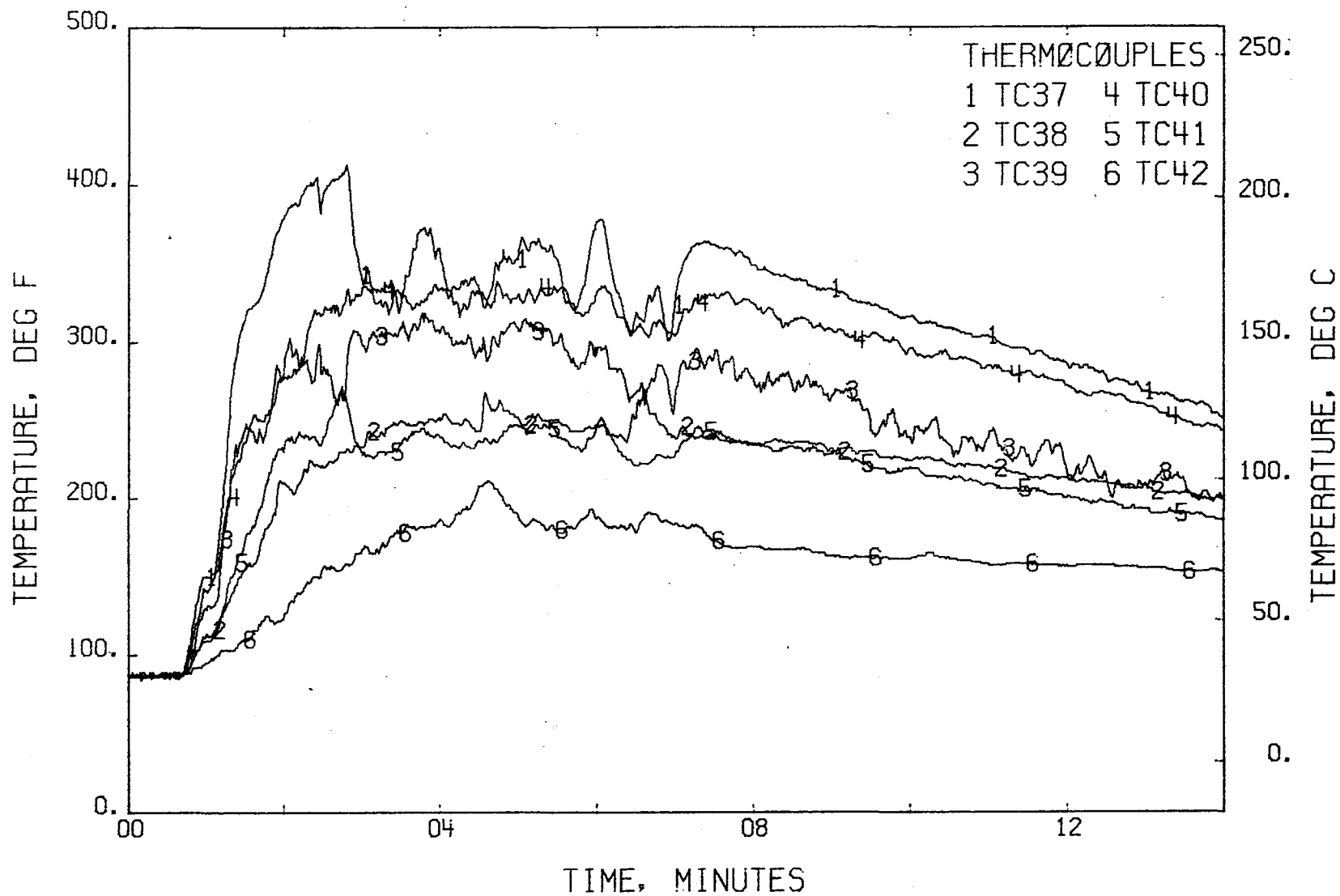


FIGURE 513 . - TEMPERATURES, T/C TREE 7  
TEST 23

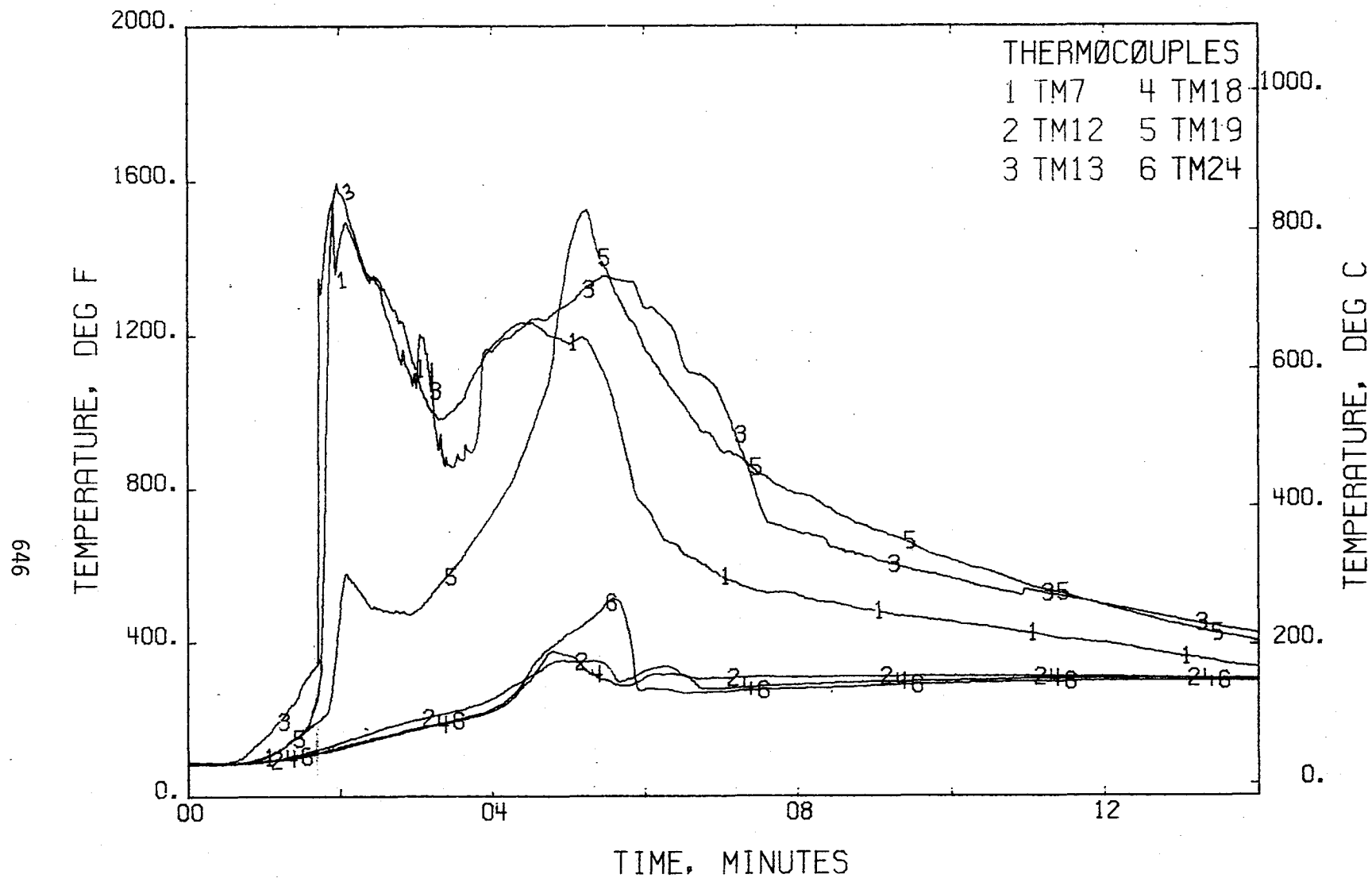


FIGURE 514 . - TEMPERATURES, PSU  
TEST 23

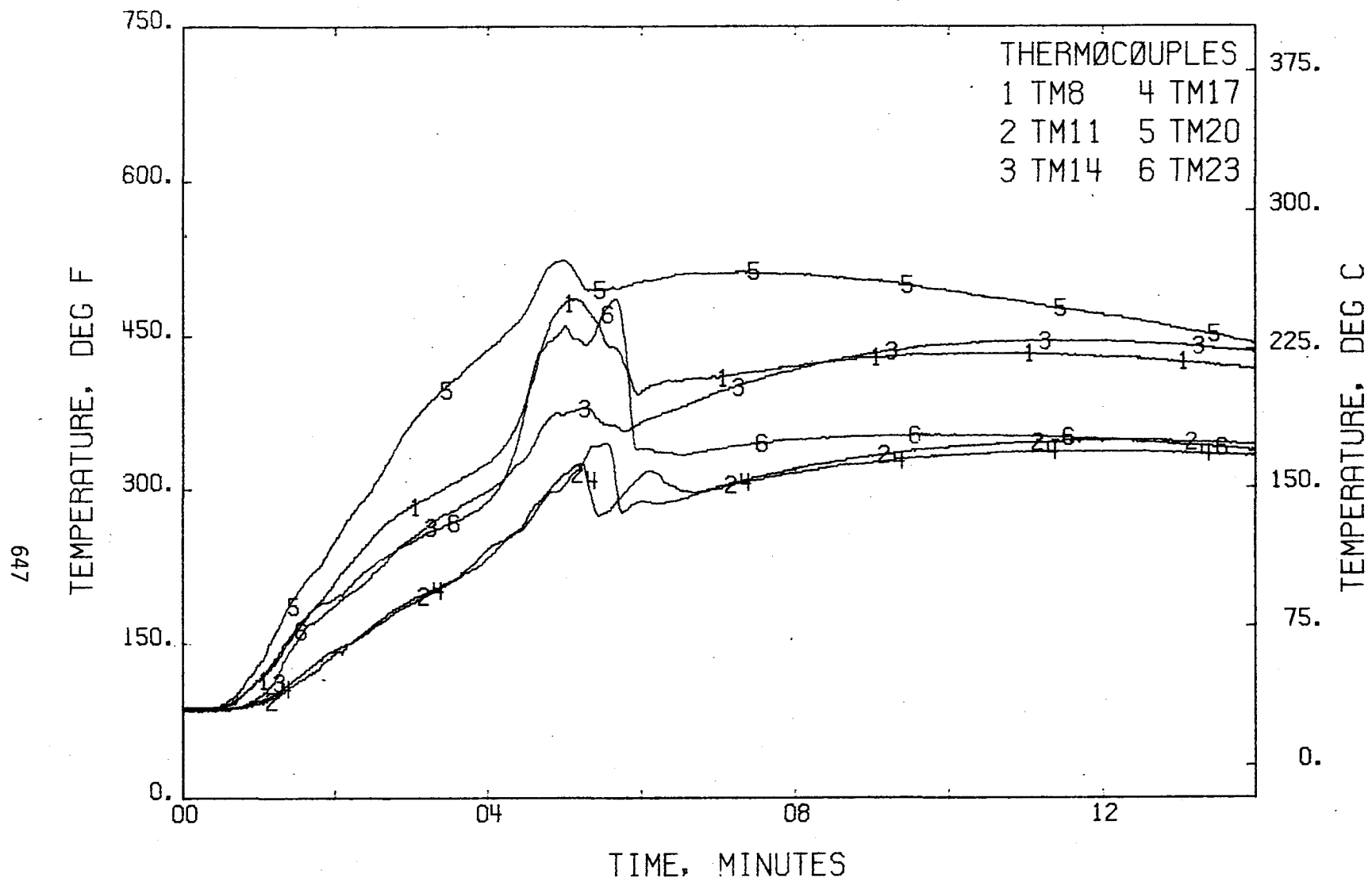


FIGURE 515 . - TEMPERATURES, STORAGE BINS  
TEST 23

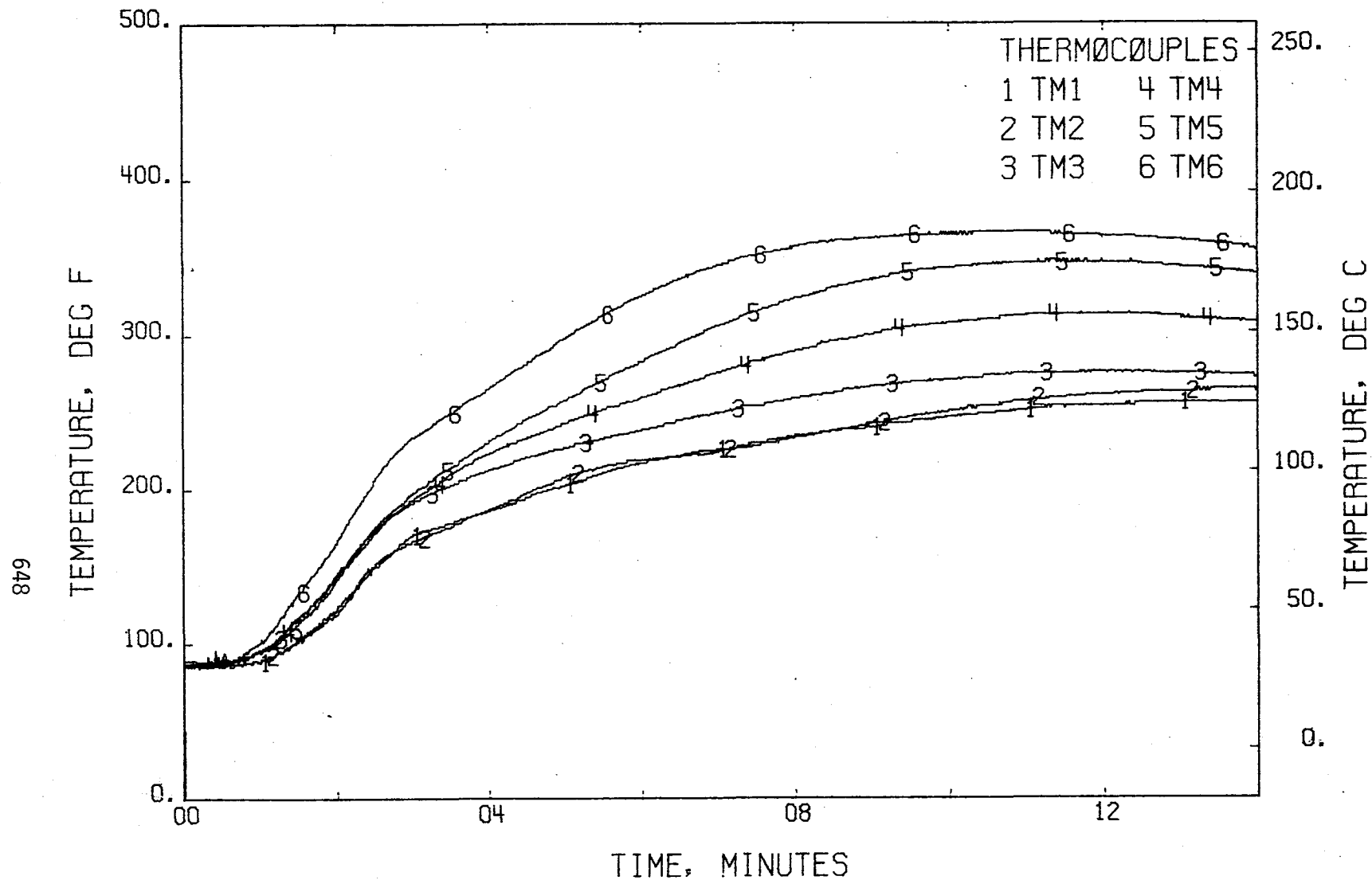


FIGURE 516 . - TEMPERATURES, CEILING PANELS (AFT)  
TEST 23



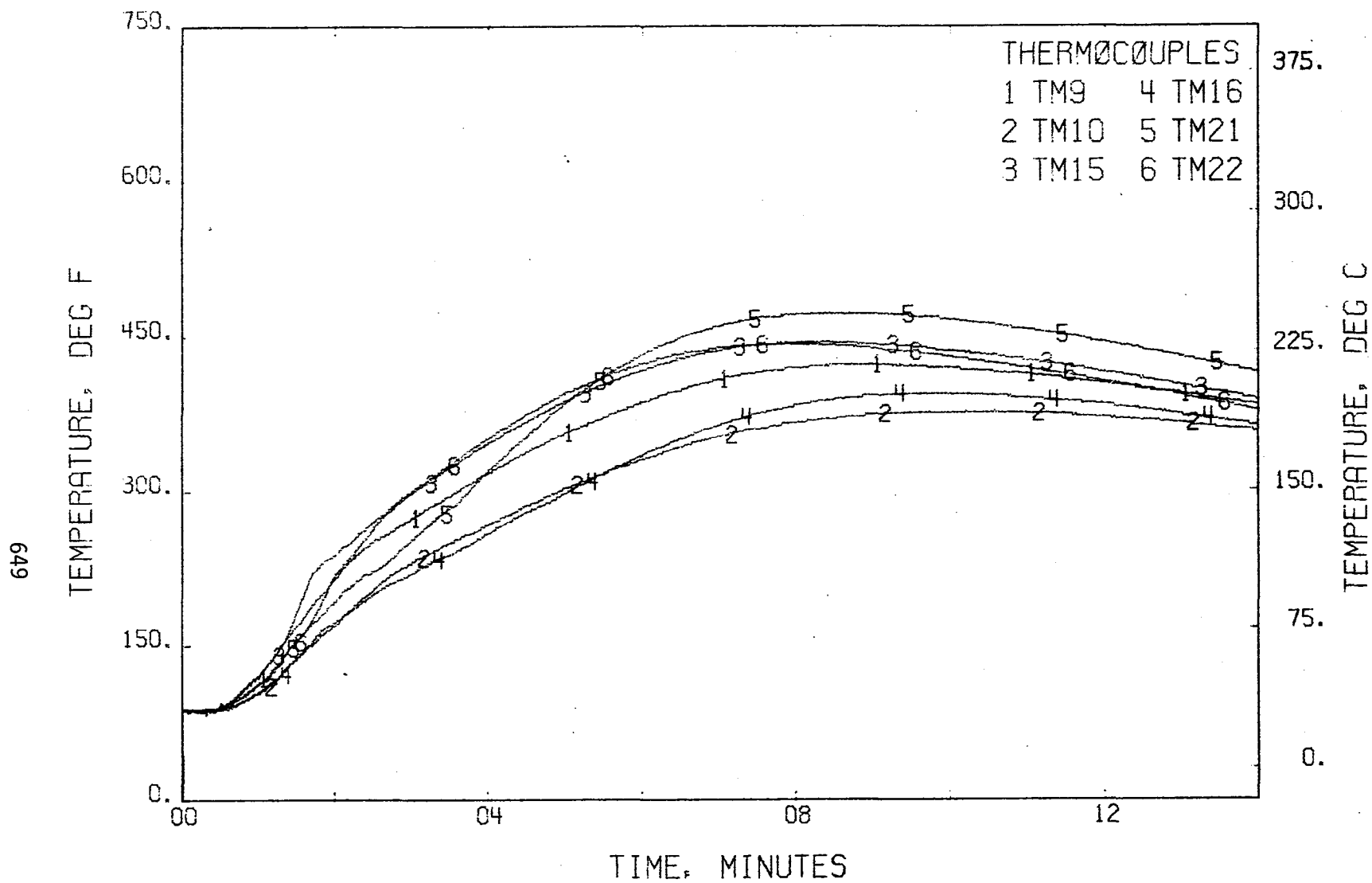


FIGURE 517 . - TEMPERATURES, CEILING PANEL (CENTER)  
TEST 23

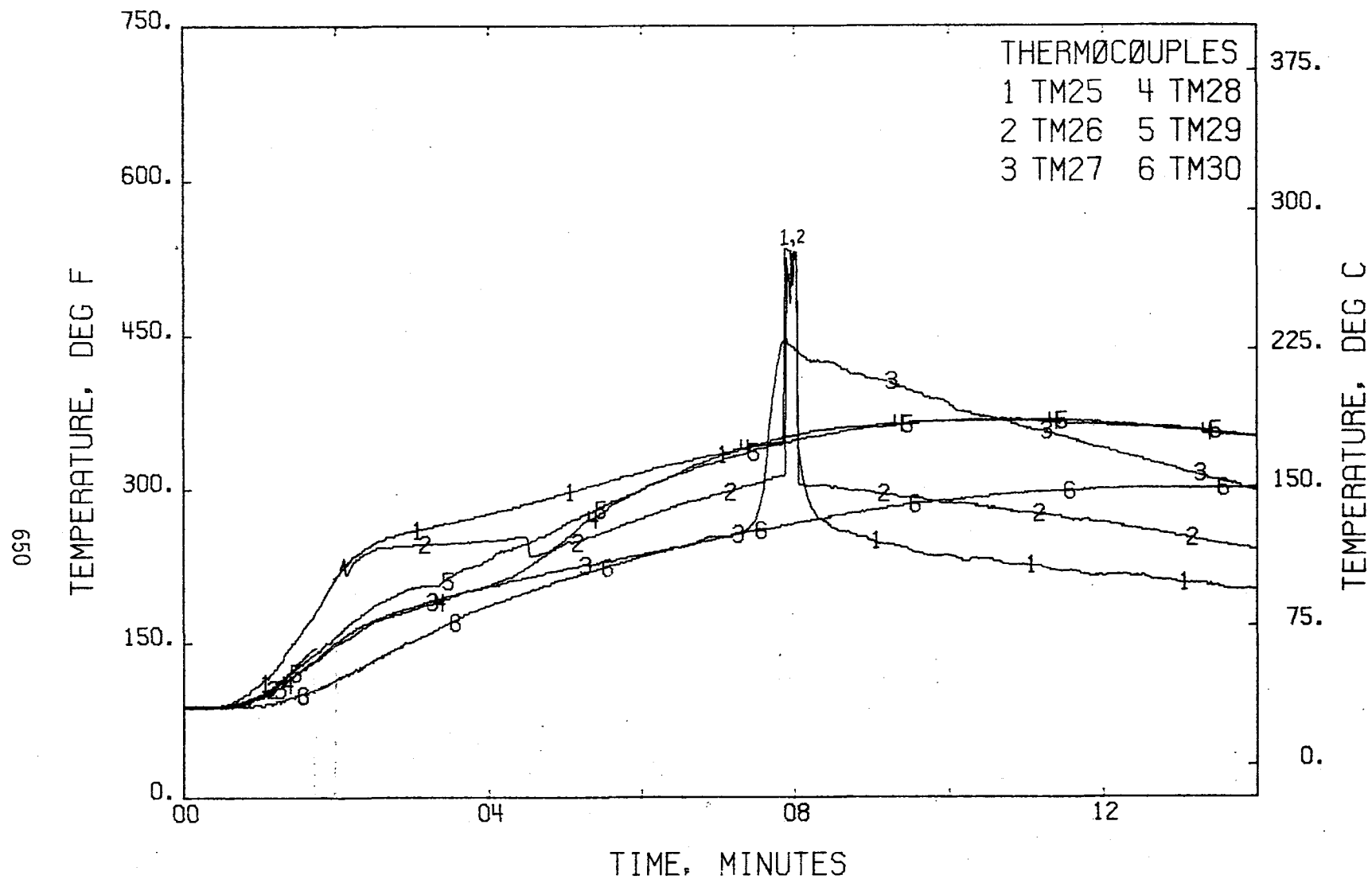


FIGURE 518 . - TEMPERATURES, CEILING PANELS (FORWARD)  
TEST 23

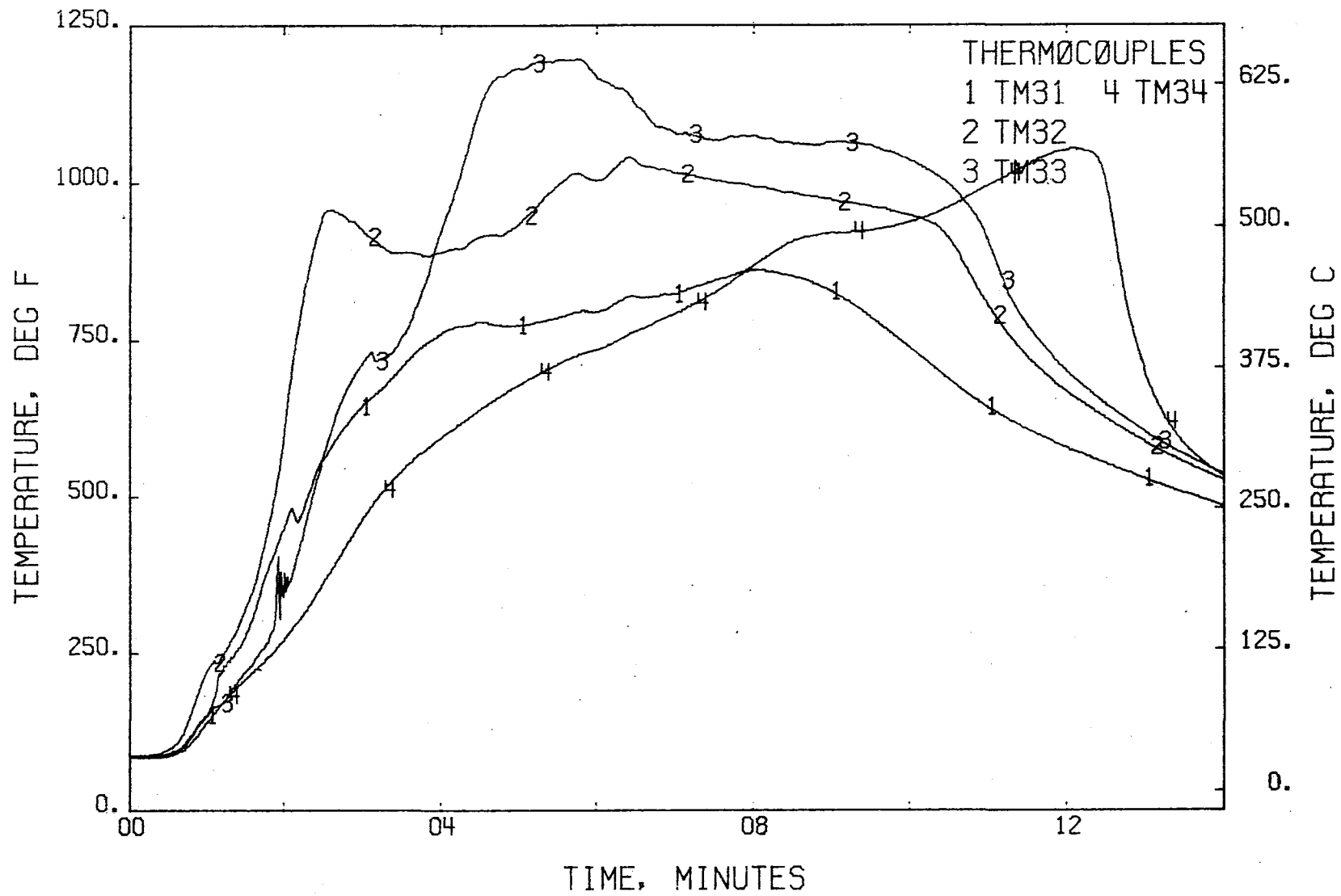


FIGURE 519. - TEMPERATURES, SIDEWALL PANEL (TØP)  
TEST 23

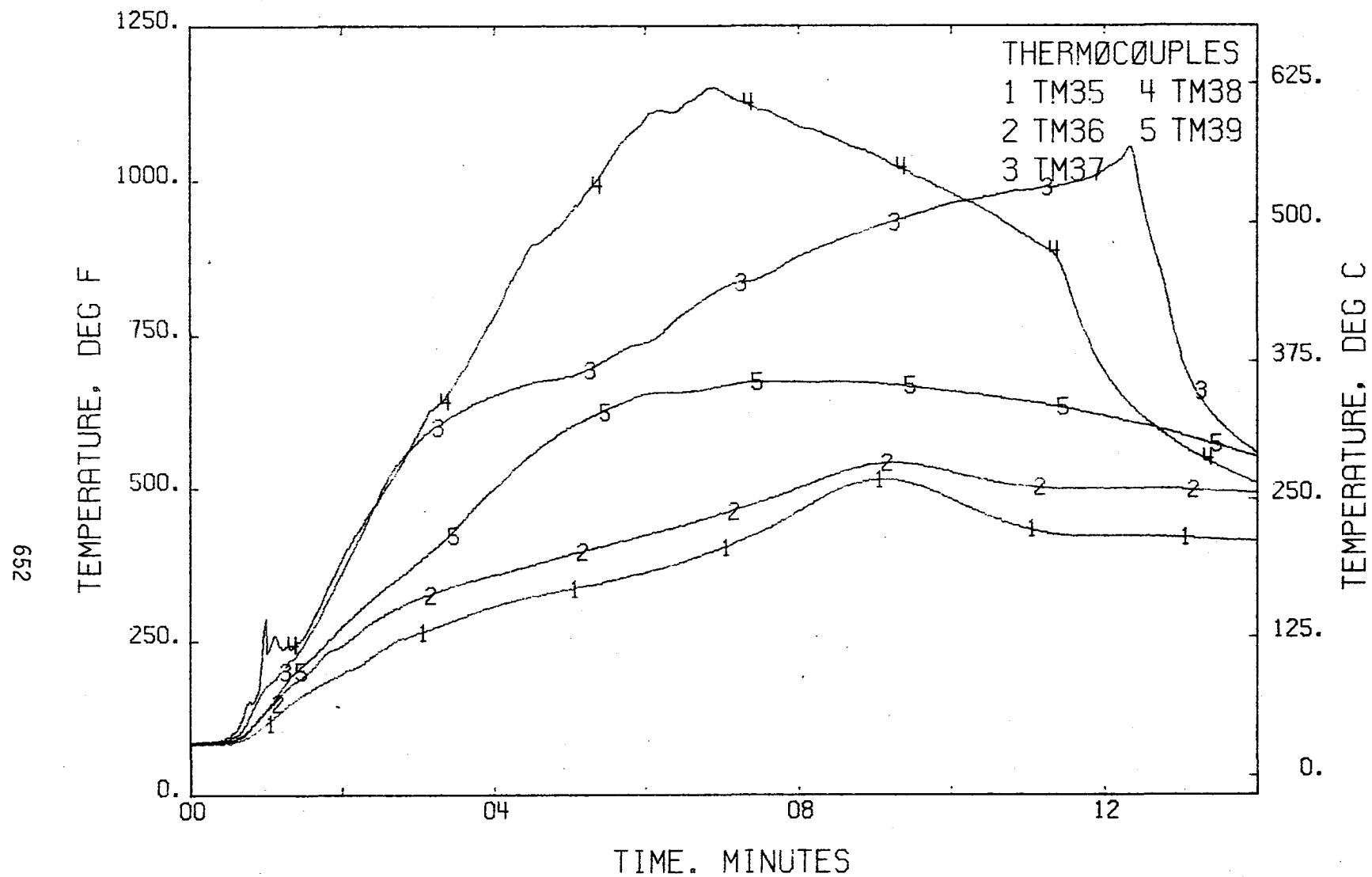


FIGURE 520 . - TEMPERATURES, SIDEWALL PANEL (CENTER)  
TEST 23

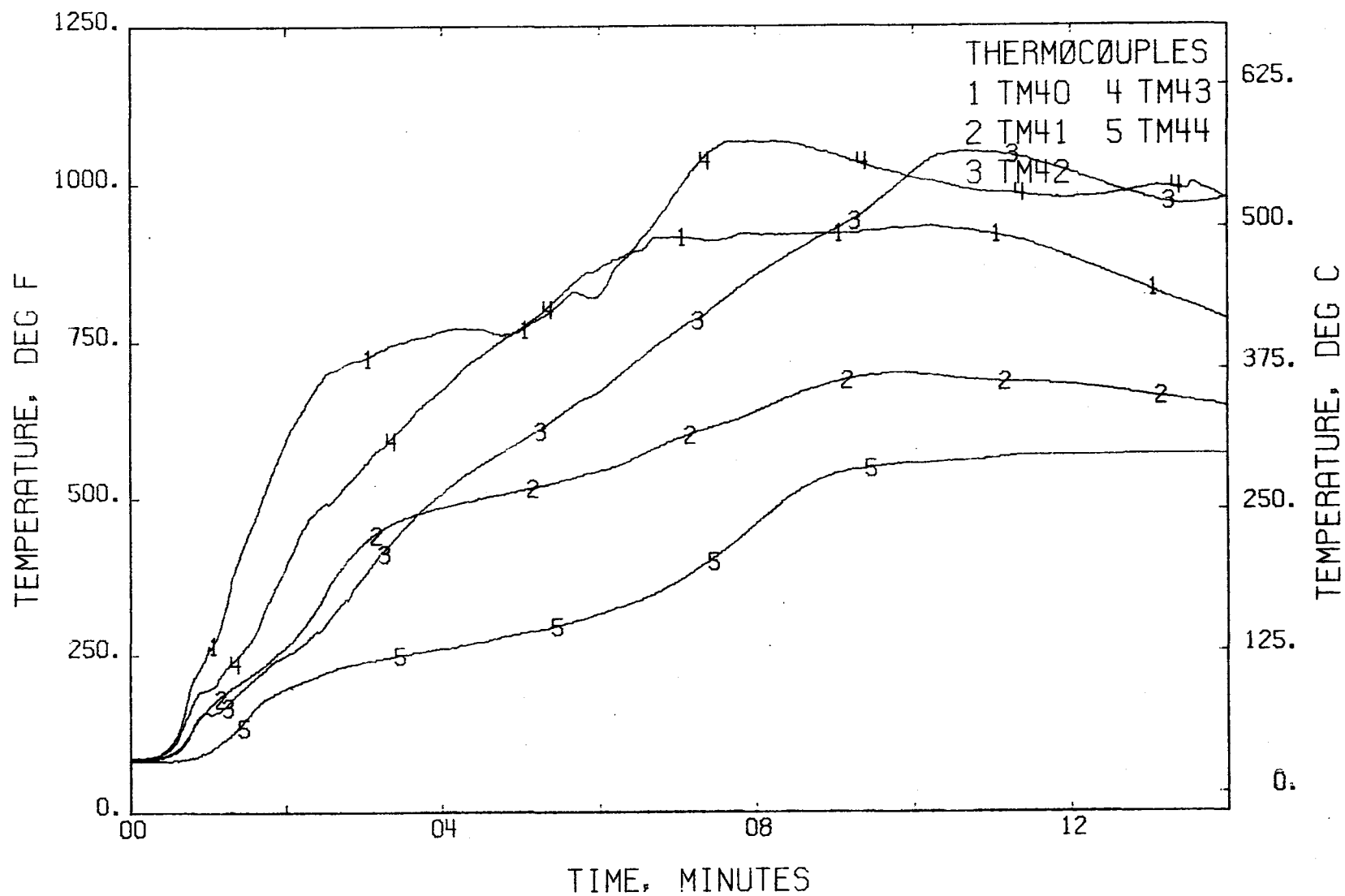


FIGURE 521 . - TEMPERATURES, SIDEWALL PANEL (BOTTOM)  
TEST 23

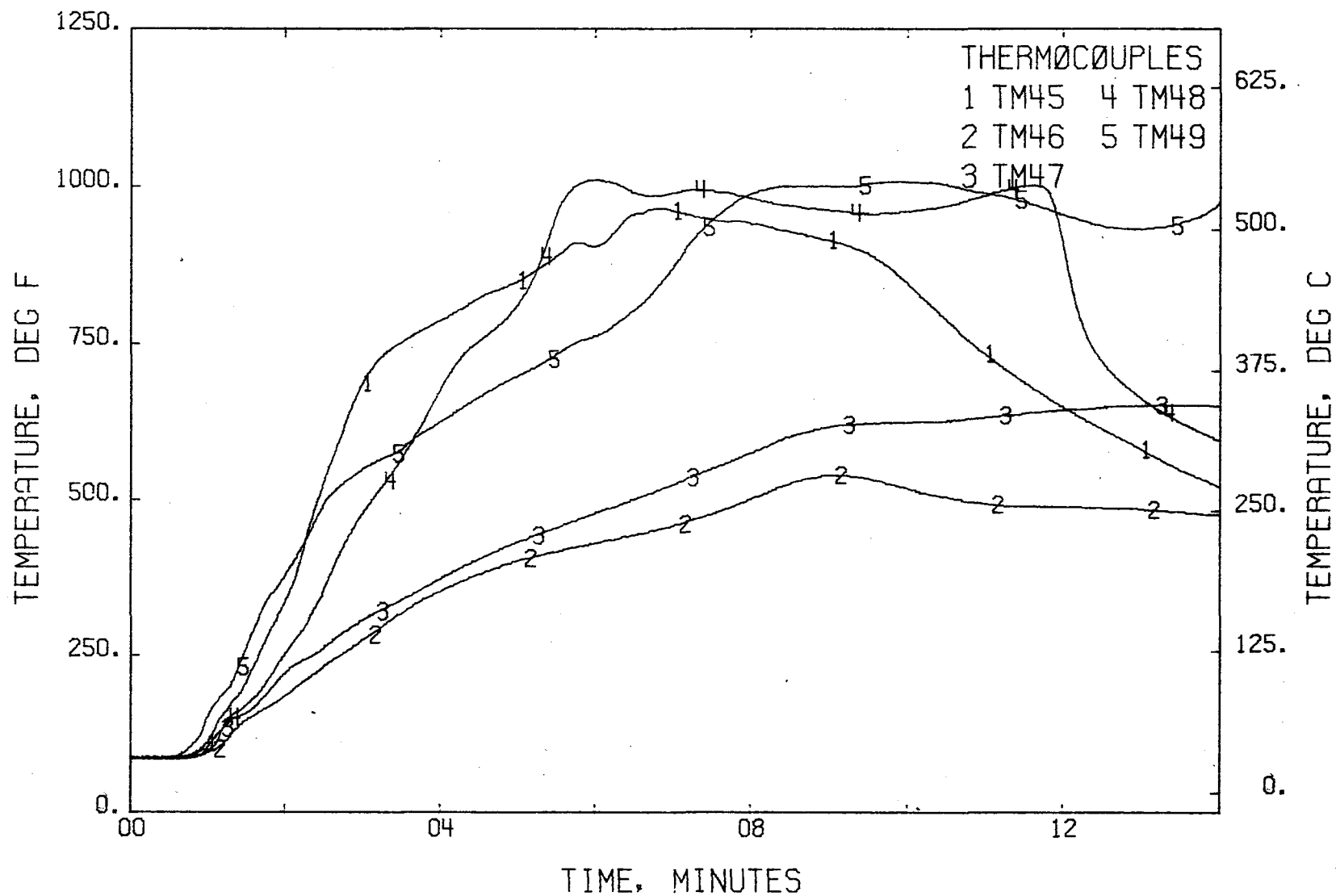


FIGURE 522 . - TEMPERATURES, SIDEWALL PANEL (REAR)  
TEST 23

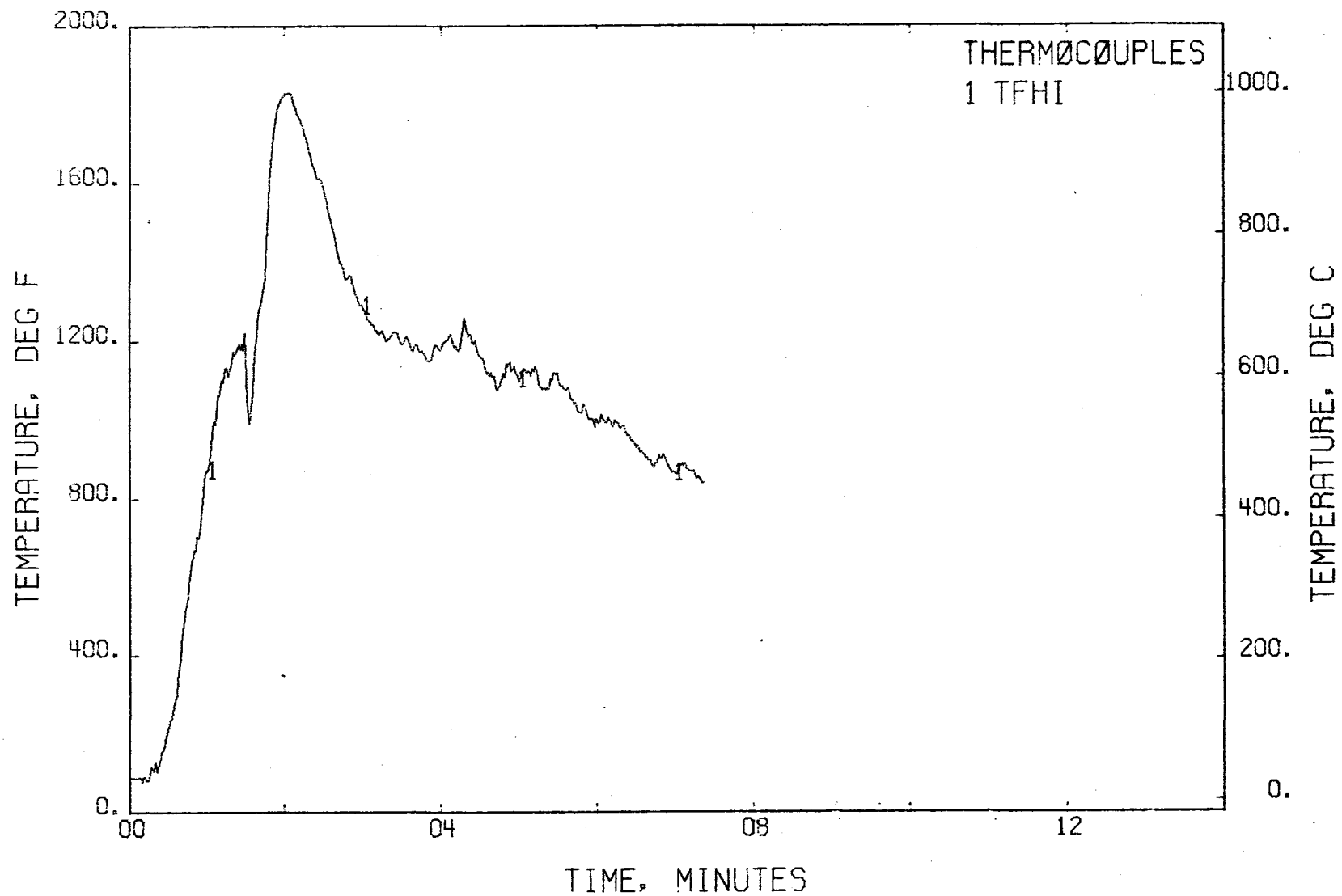


FIGURE 523 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 23

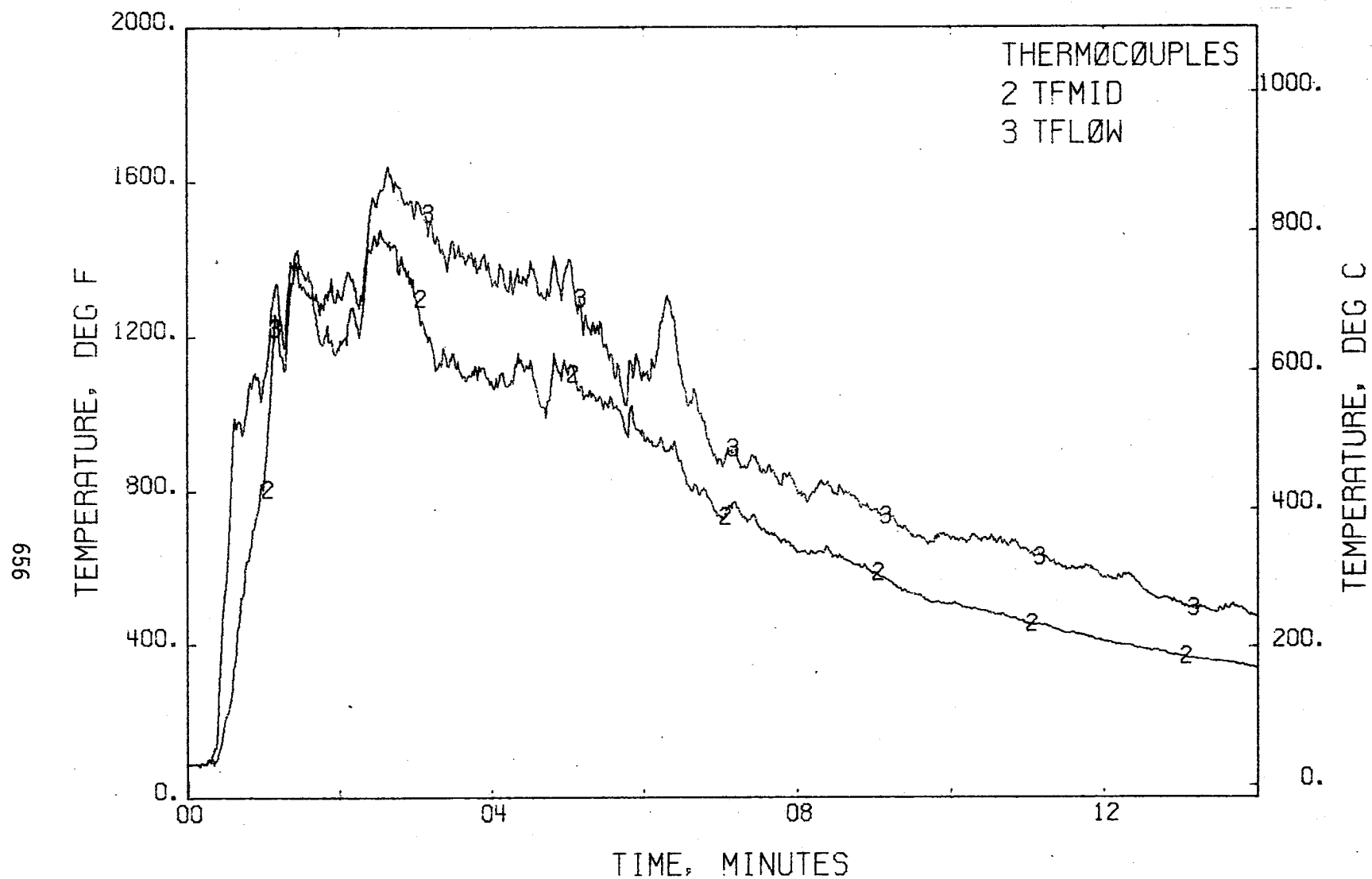


FIGURE 523 . - TEMPERATURES, ABOVE FUEL PAN - CONT.  
TEST 23



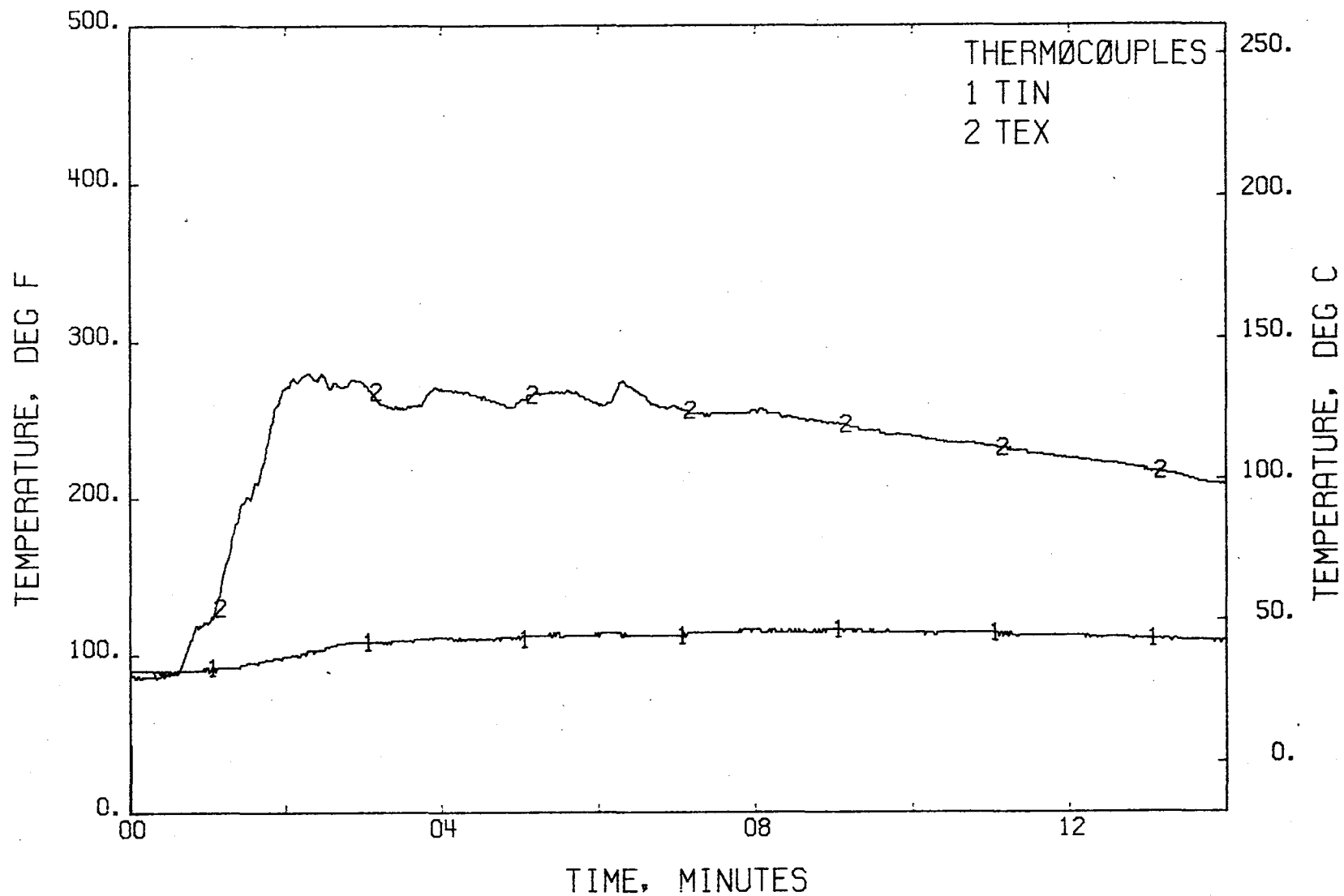


FIGURE 524 . - TEMPERATURES, INLET + EXIT  
TEST 23

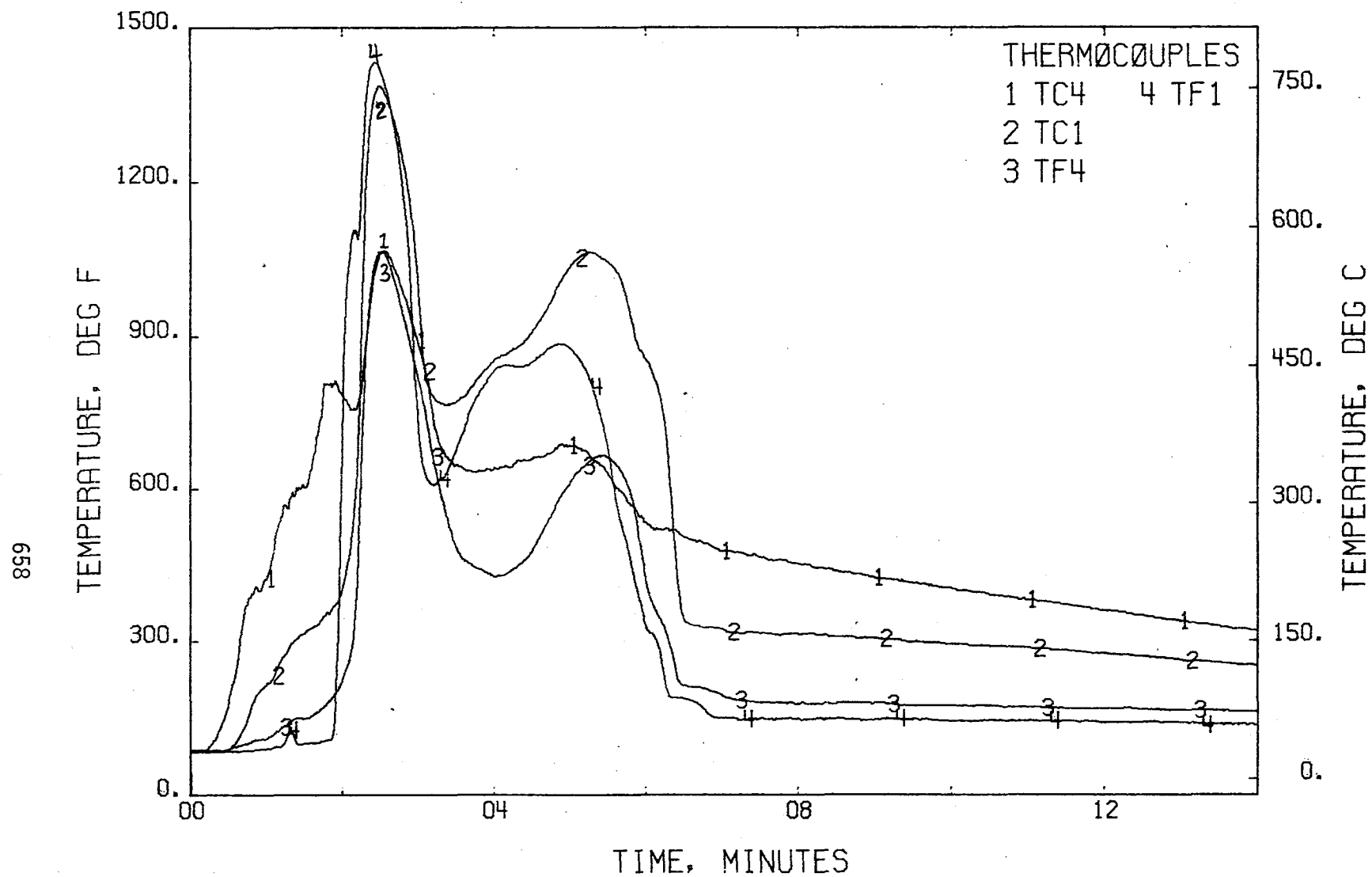


FIGURE 525 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 23

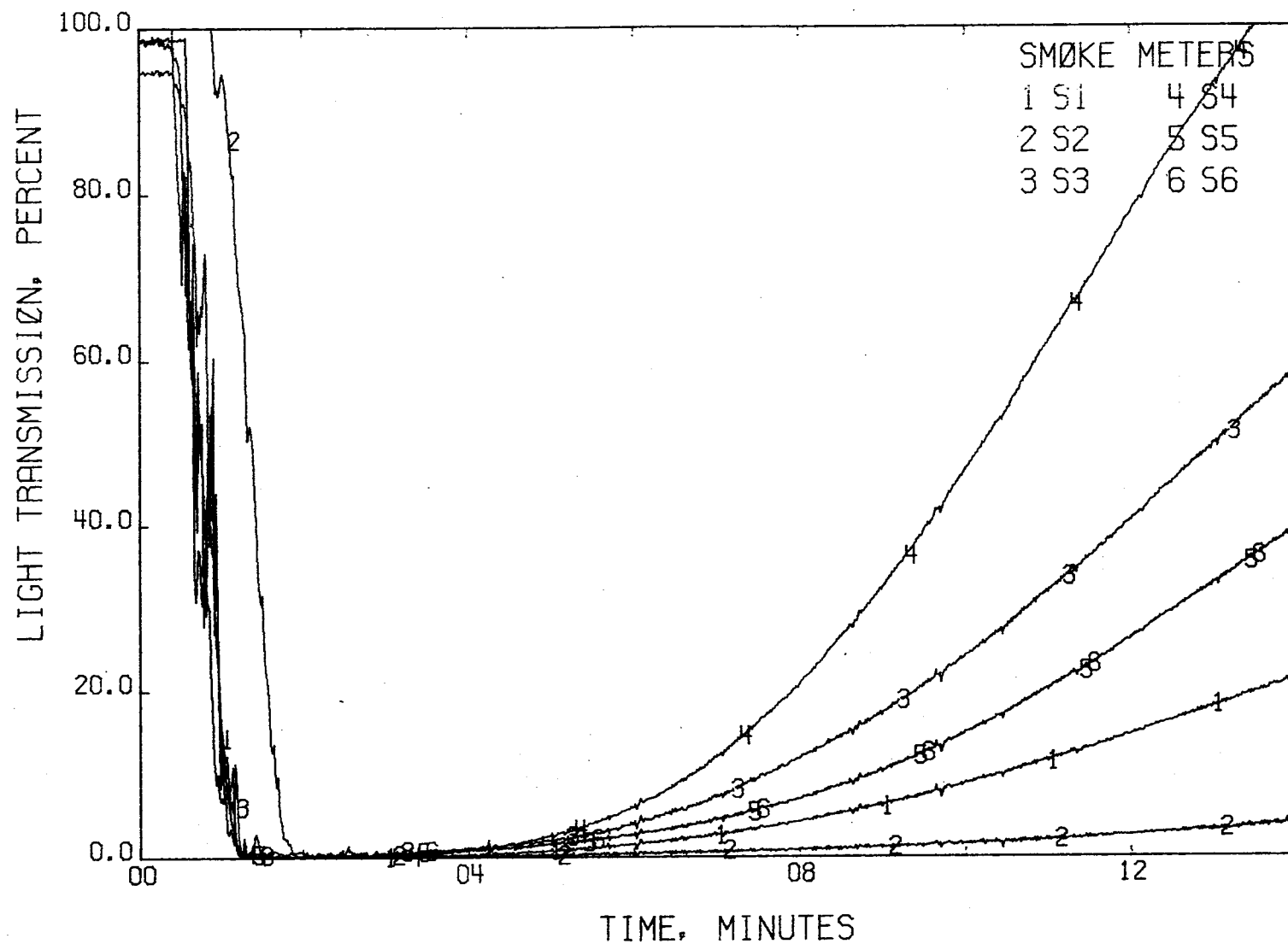


FIGURE 526 . - LIGHT TRANSMISSION  
TEST 23

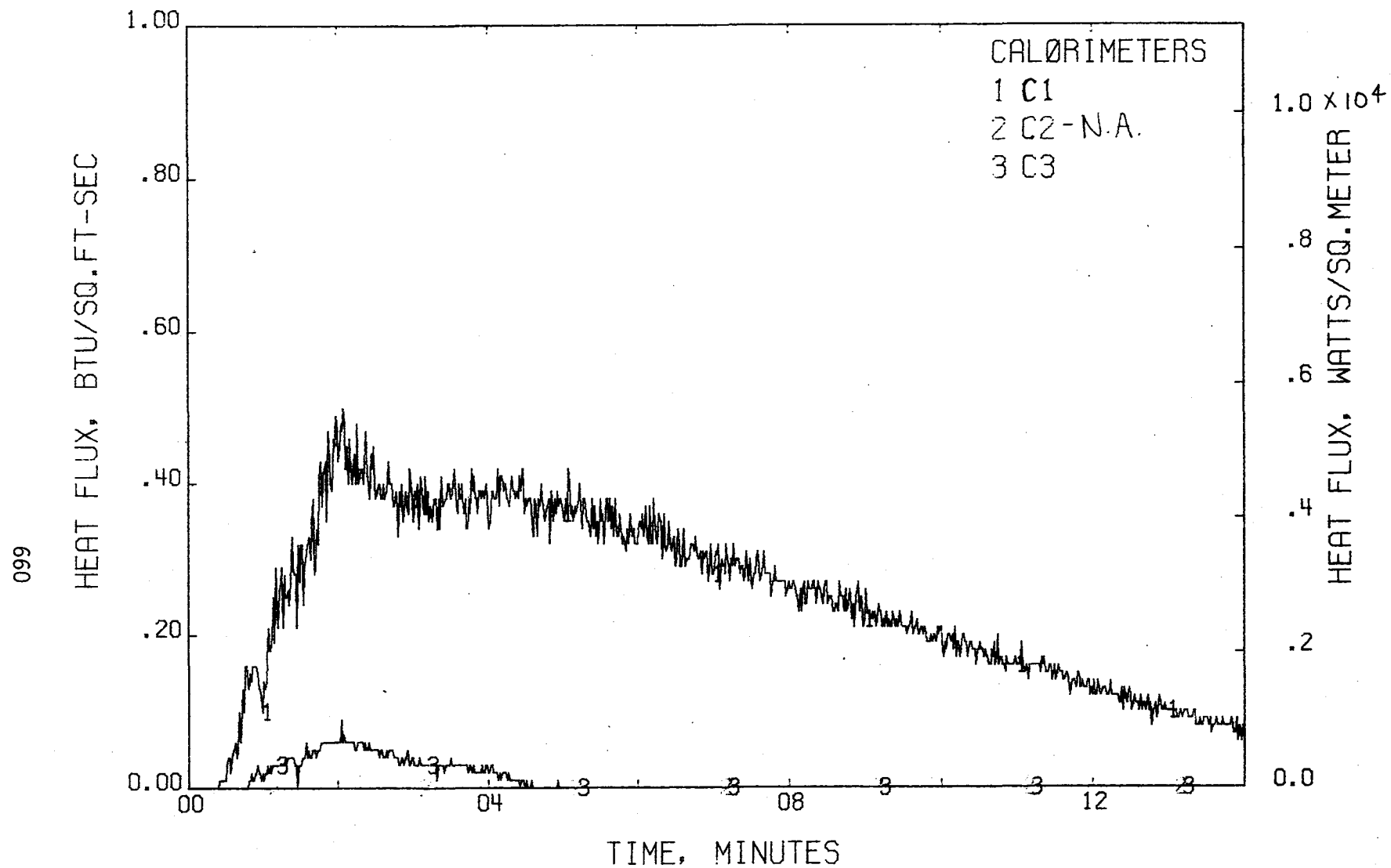


FIGURE 527 . - HEAT FLUX, AFT  
TEST 23

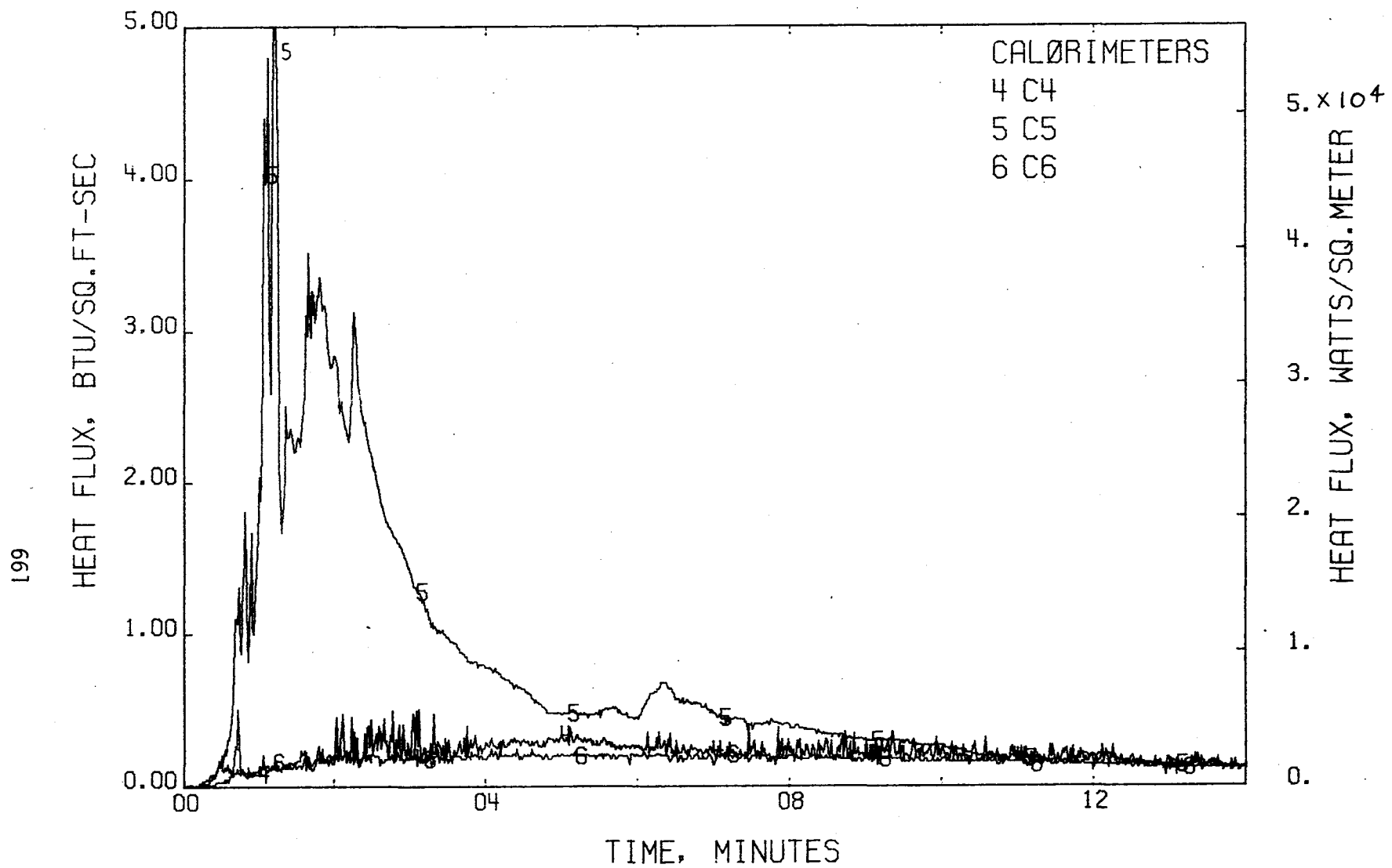


FIGURE 528 . - HEAT FLUX, MIDSECTION  
TEST 23

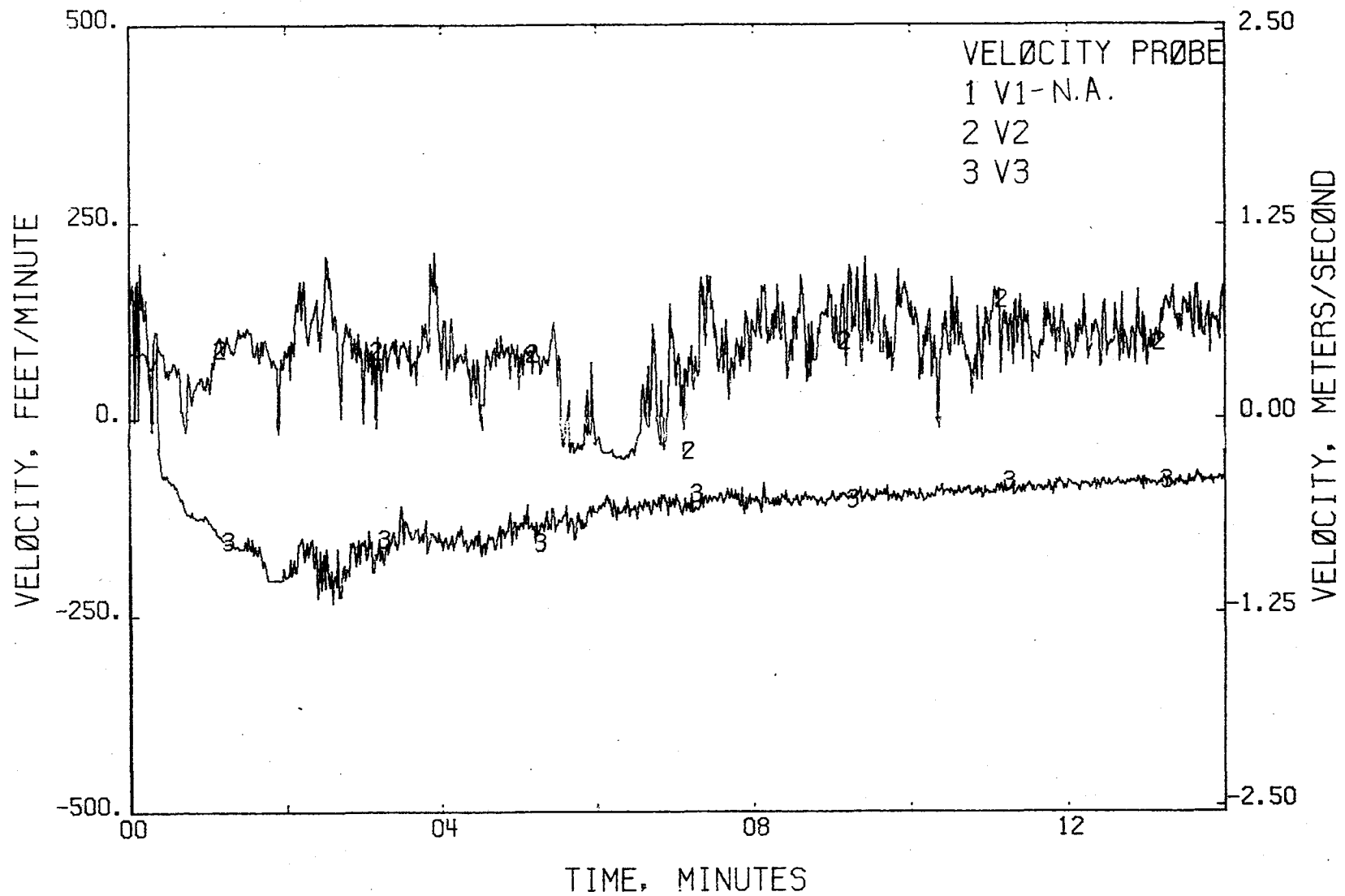


FIGURE 529 . - AIR VELOCITY  
TEST 23

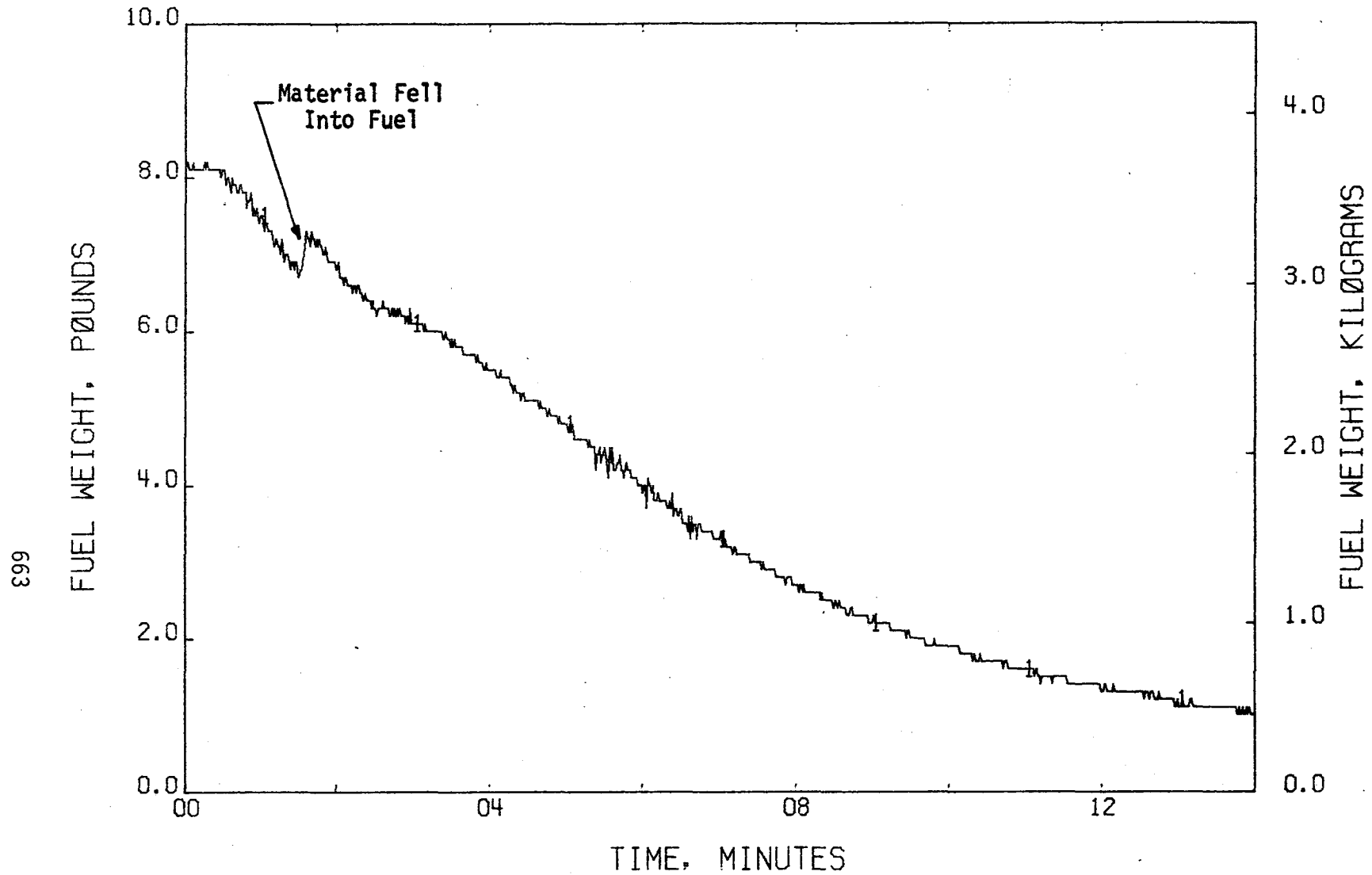


FIGURE 530 . - FUEL WEIGHT LOSS  
TEST 23

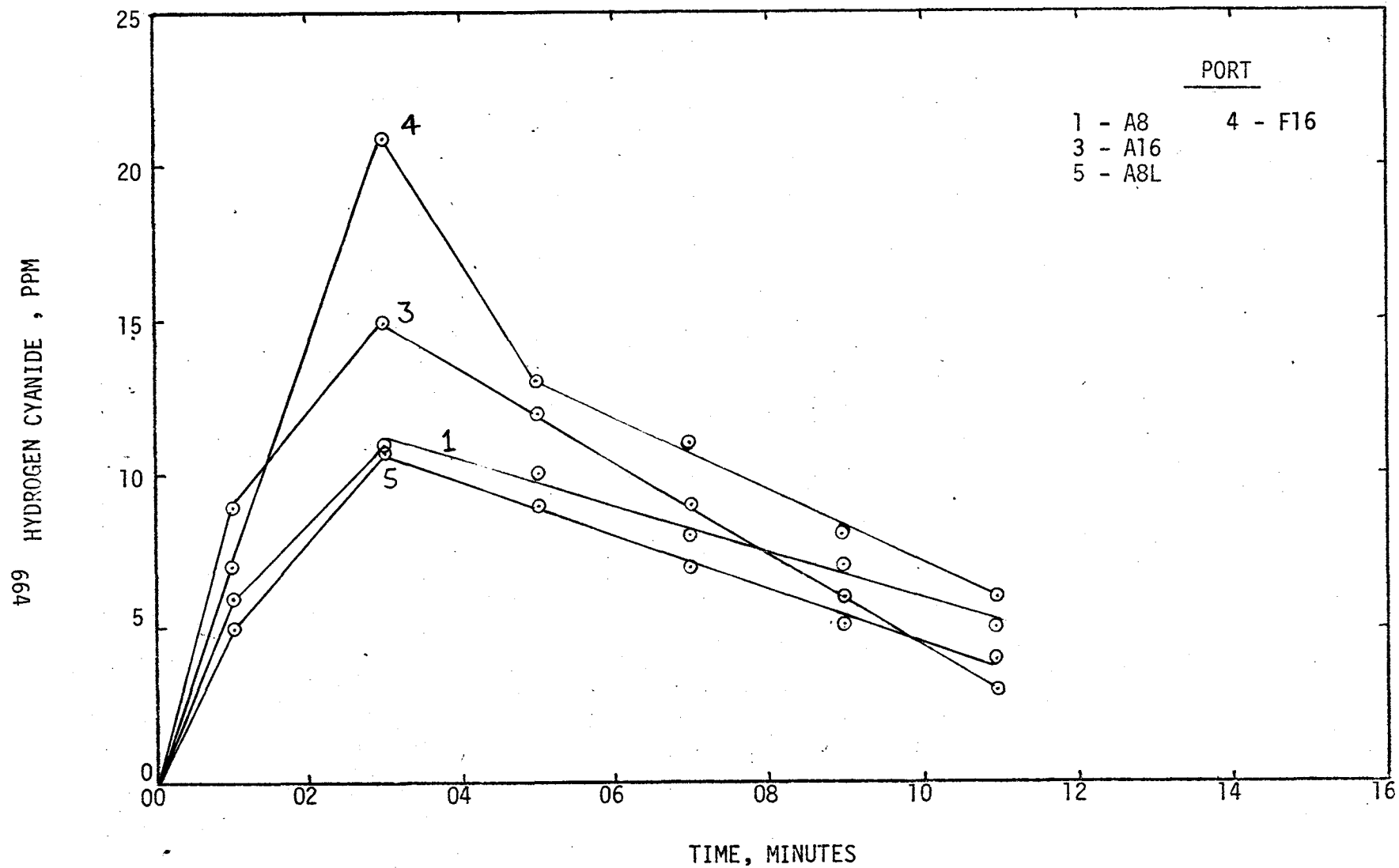


FIGURE 531 - HYDROGEN CYANIDE CONCENTRATIONS  
TEST 23



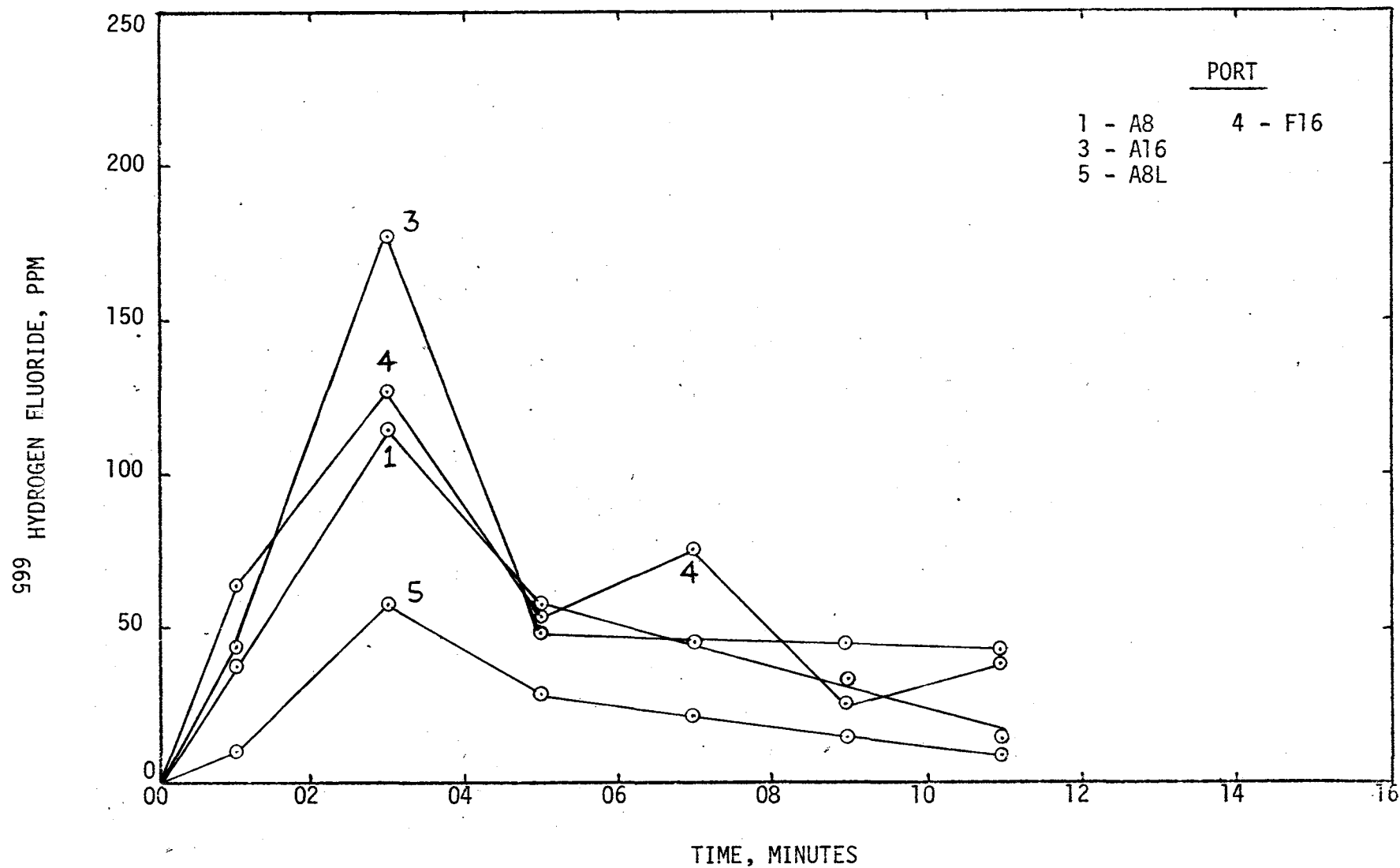


FIGURE 532 : - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 23

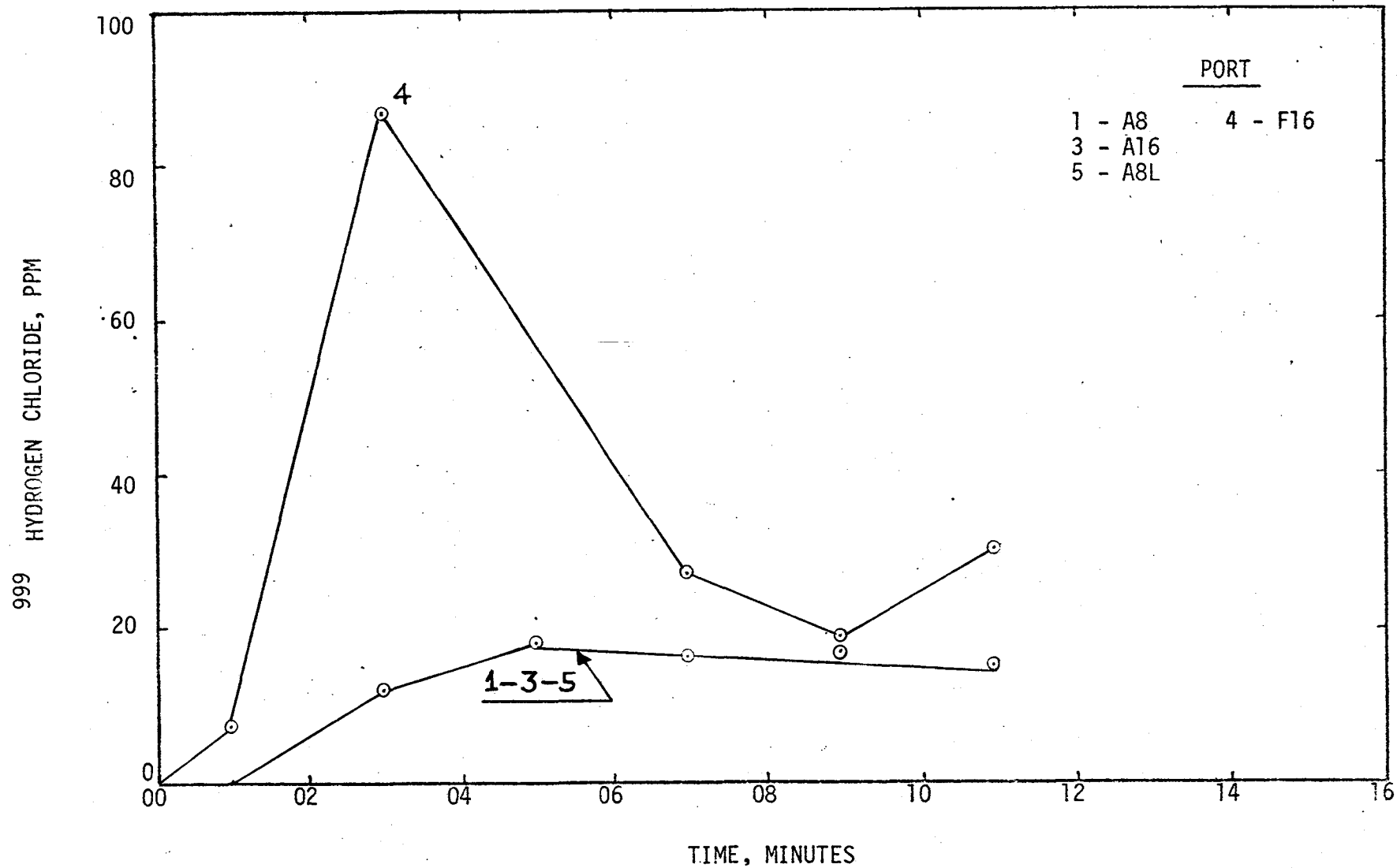


FIGURE 533 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 23

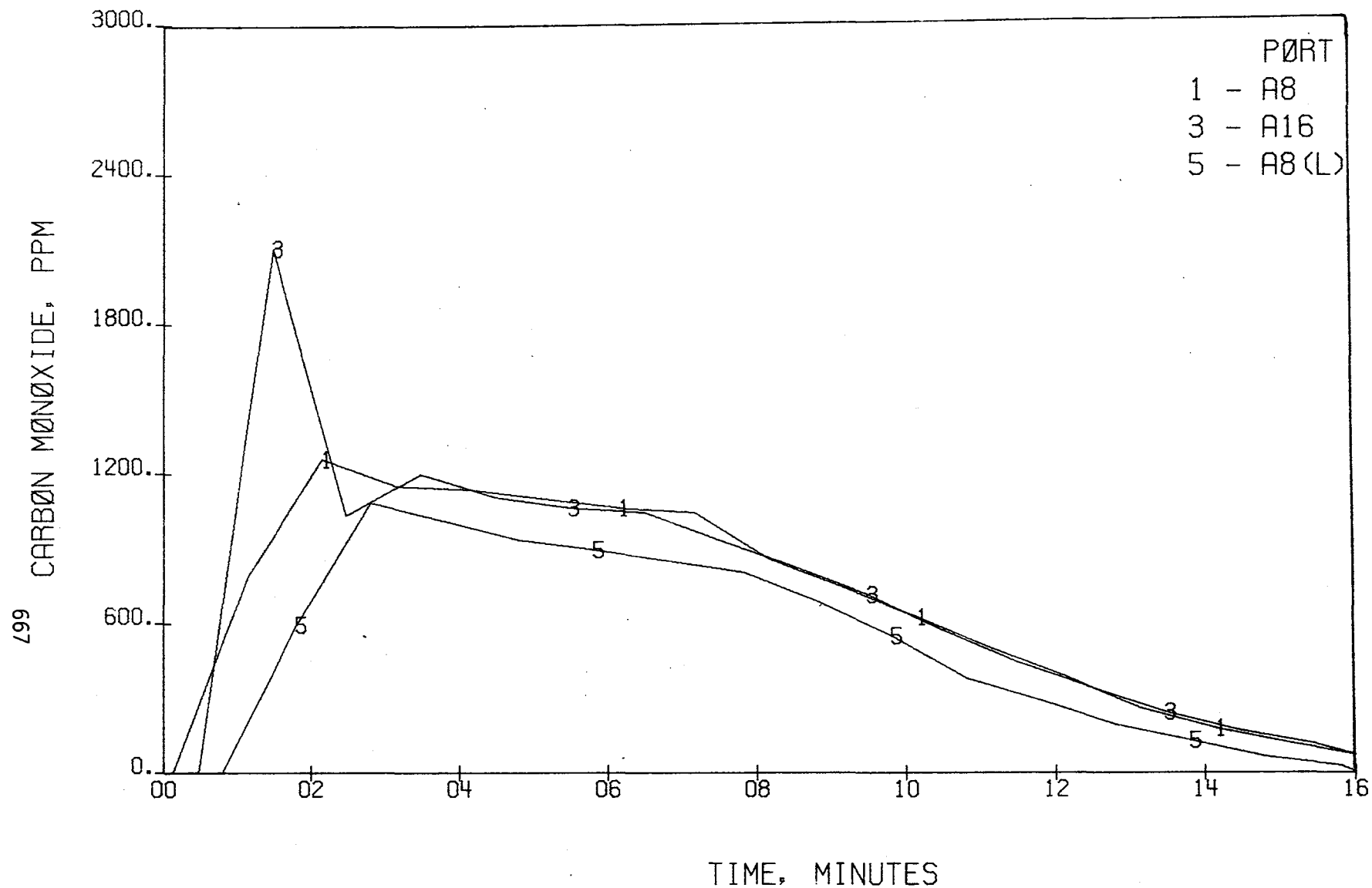


FIGURE 534. - CARBON MONOXIDE CONCENTRATIONS, AFT  
TEST 23

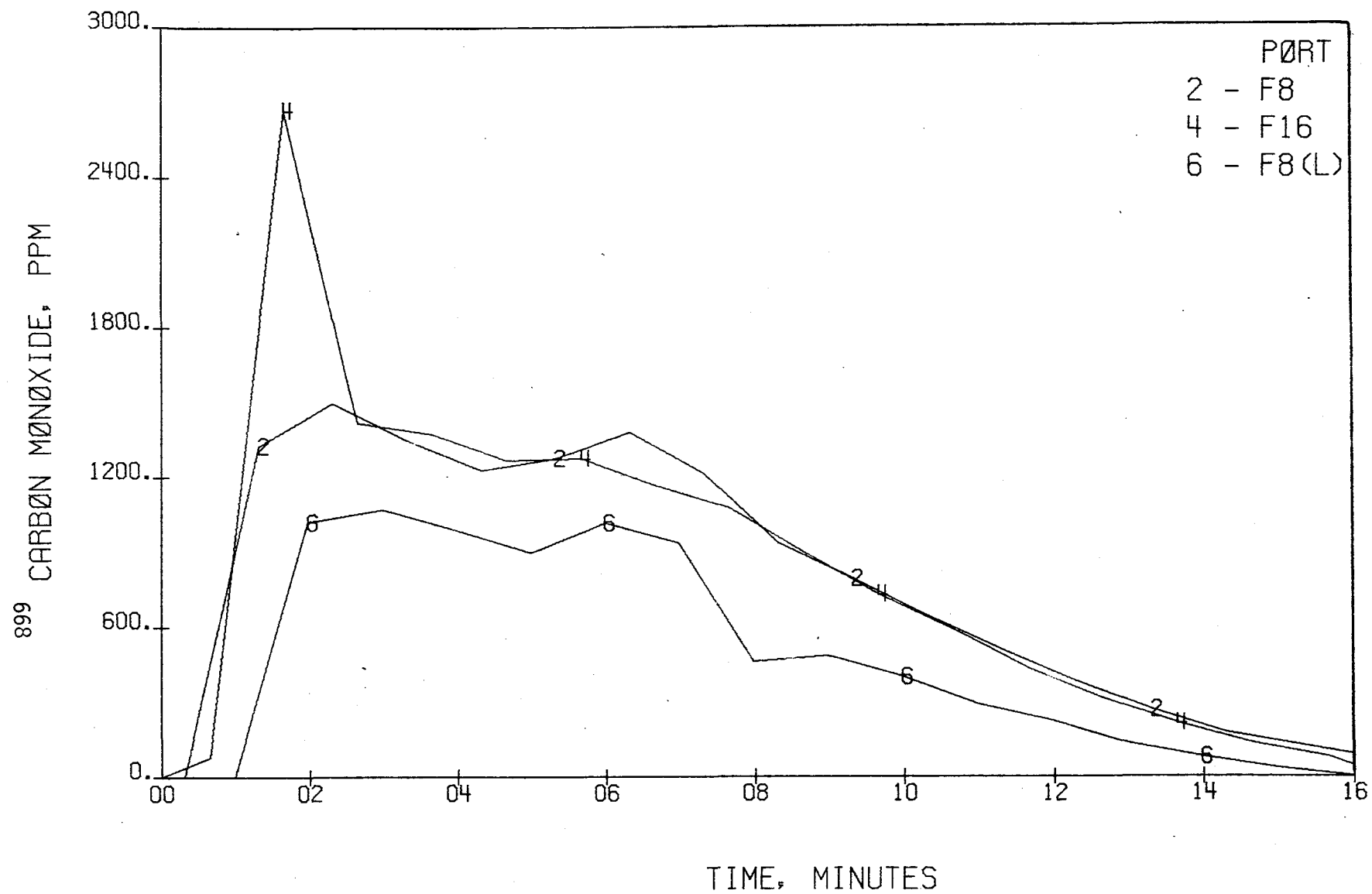


FIGURE 535 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 23

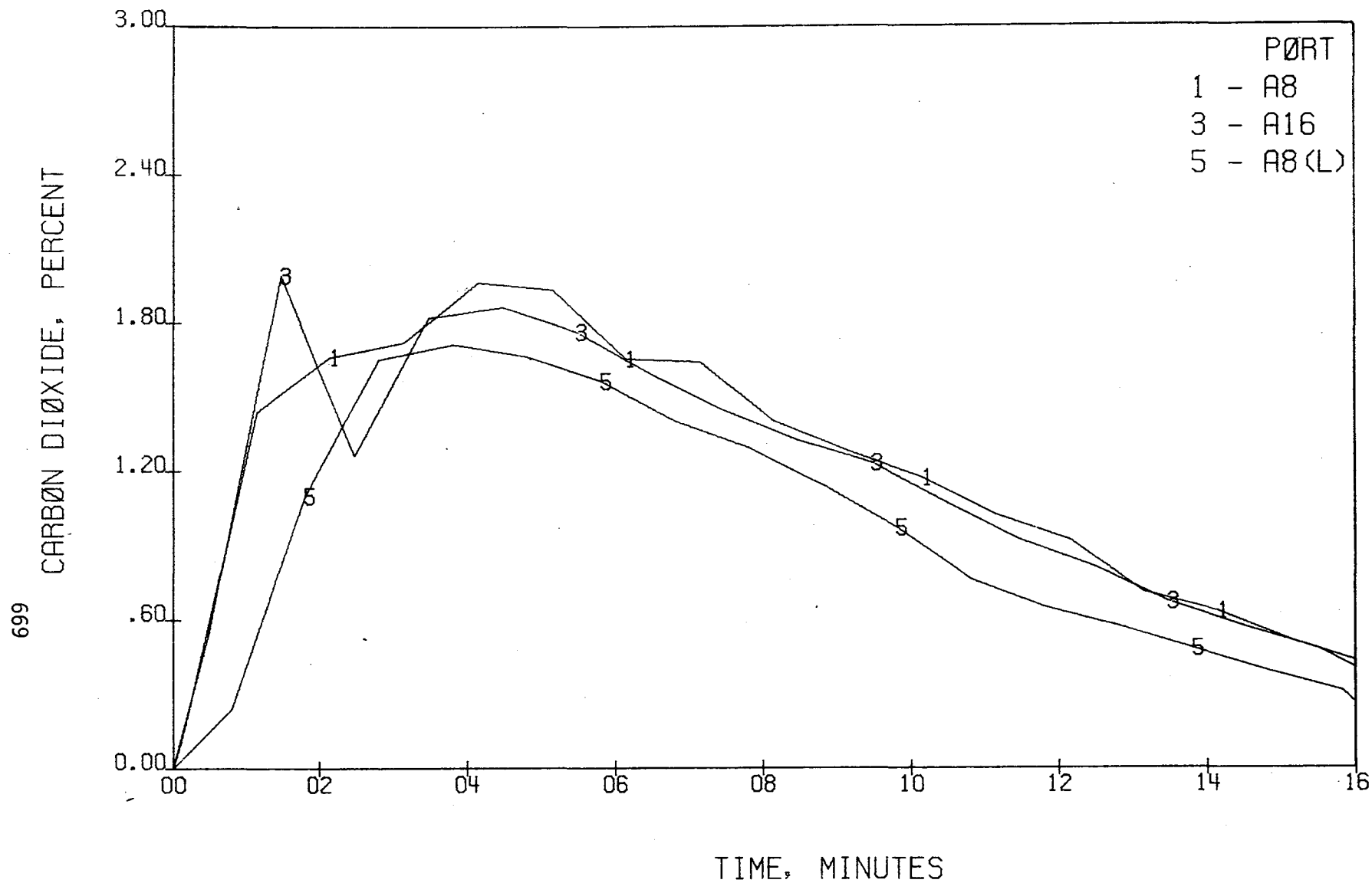


FIGURE 536 . - CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 23

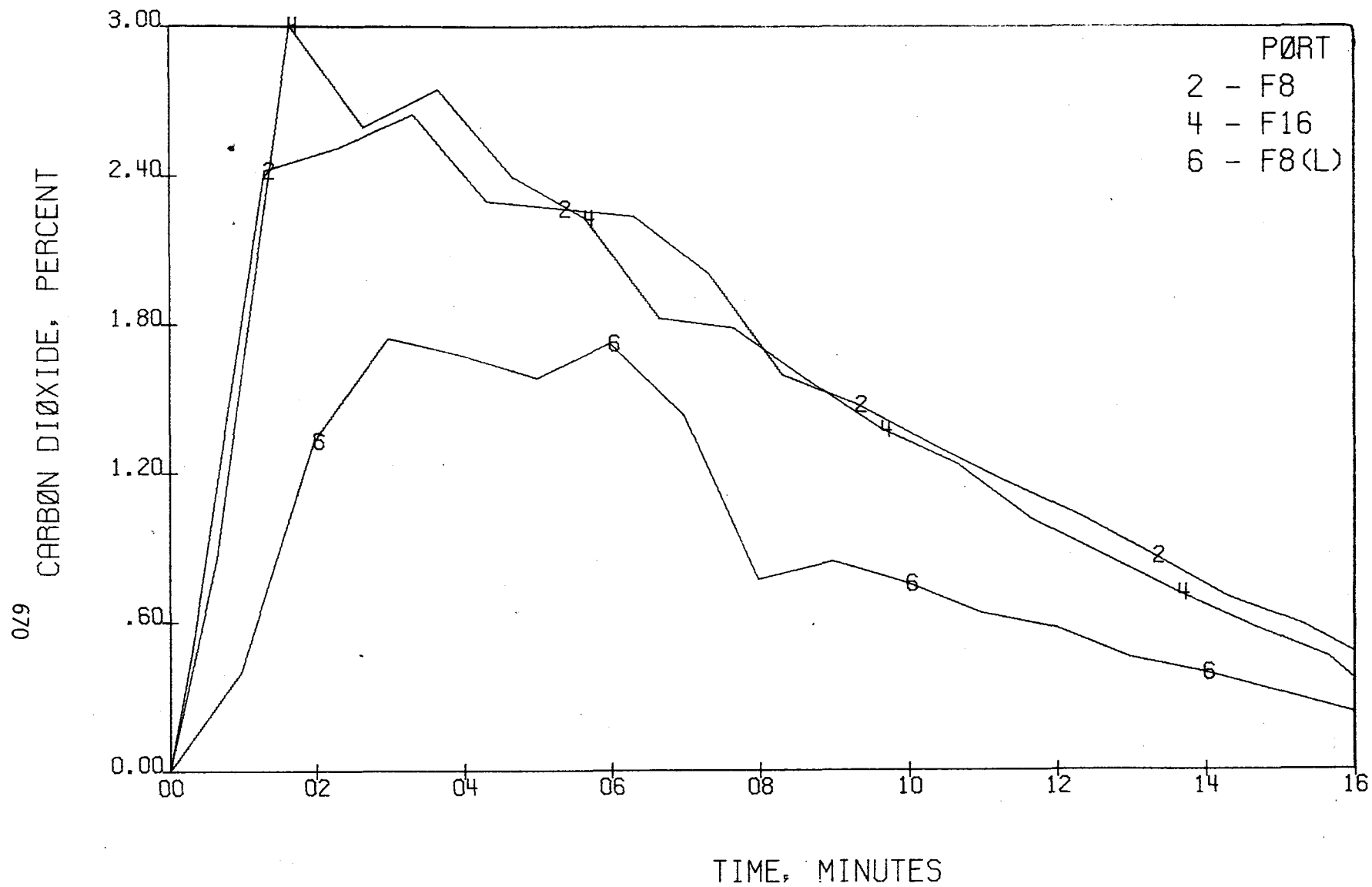


FIGURE 537. - CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 23

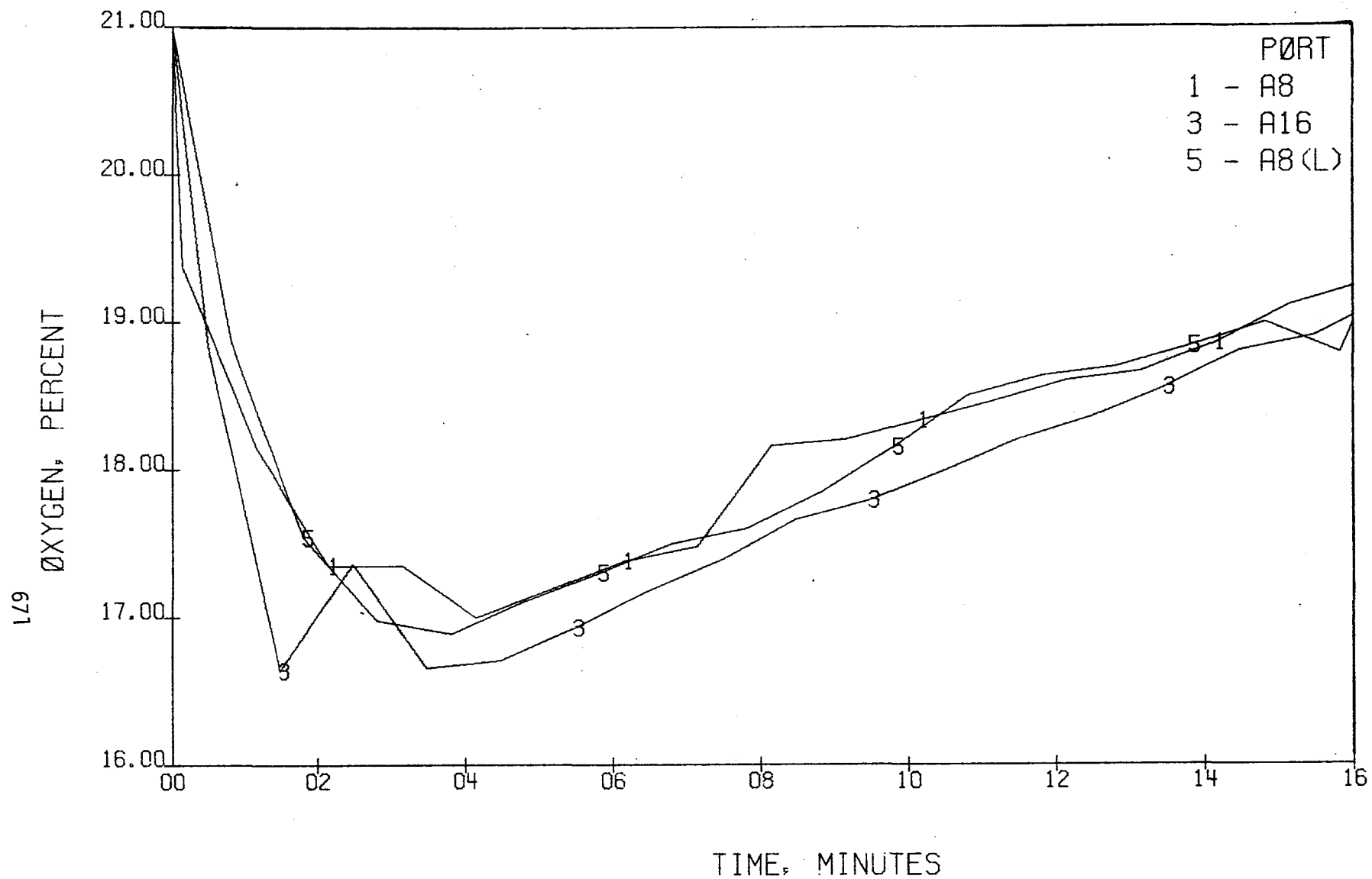


FIGURE 538 . - OXYGEN CONCENTRATIONS , AFT  
TEST 23

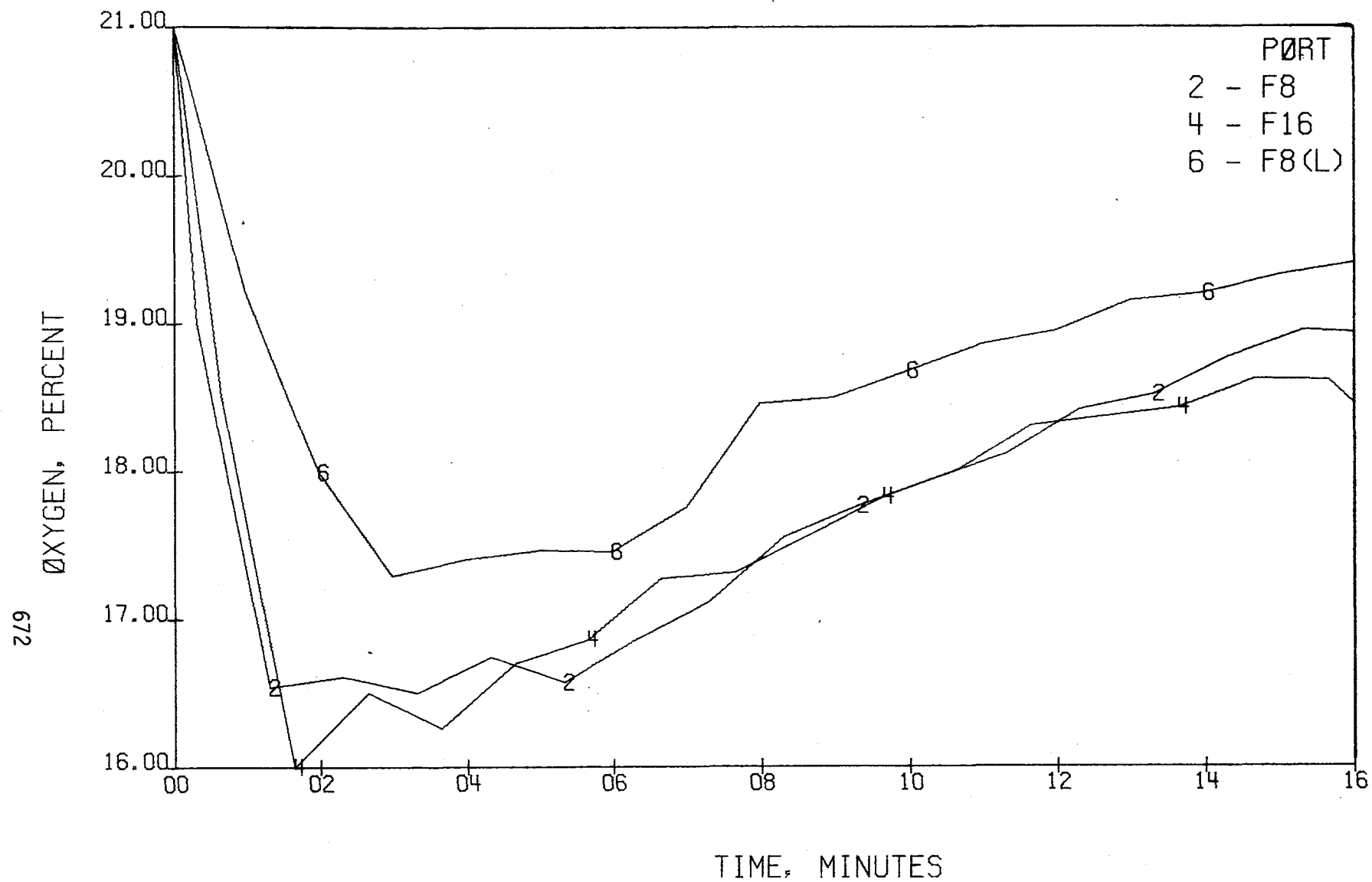


FIGURE 539 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 23



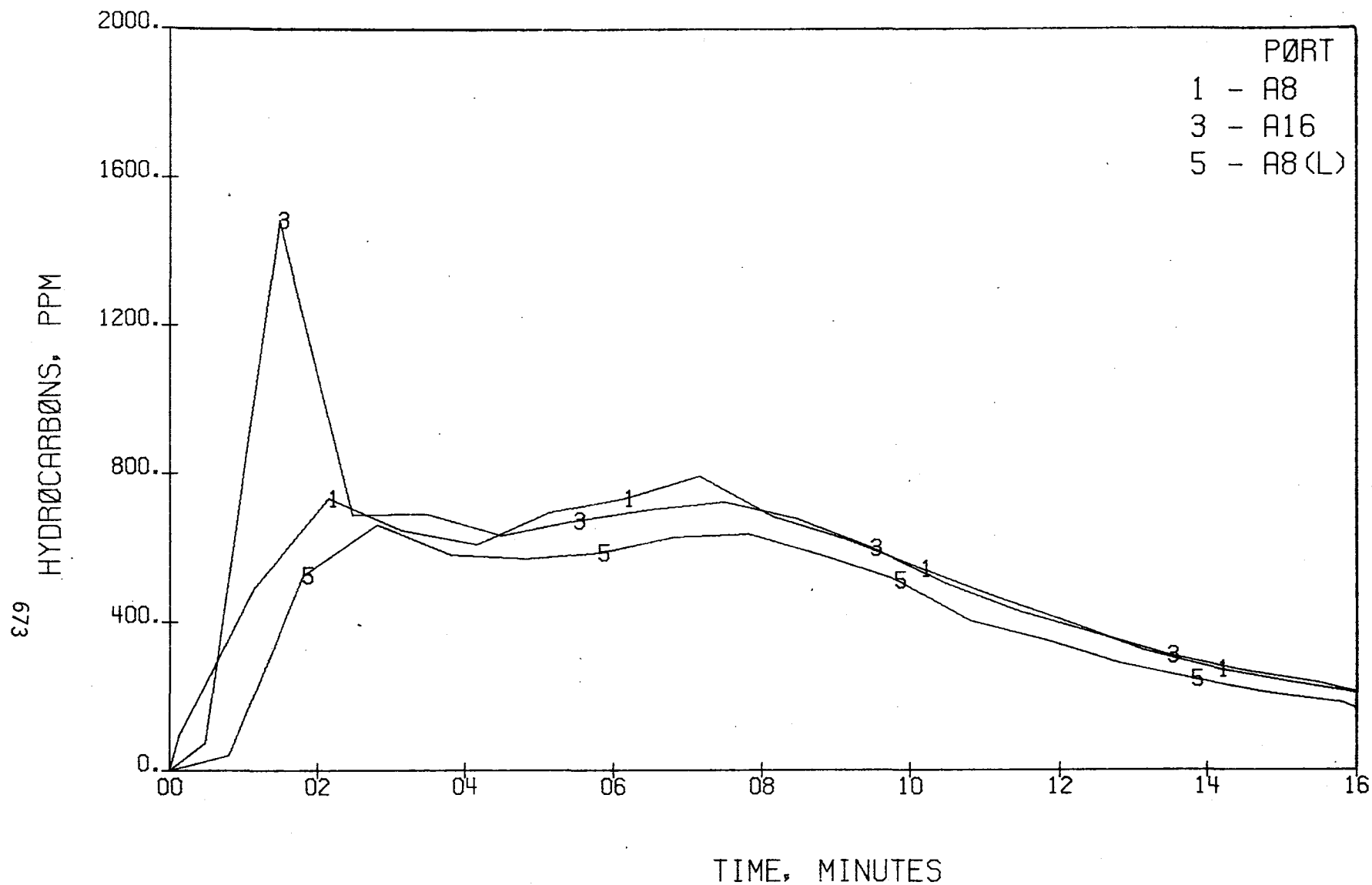


FIGURE 540. - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 23

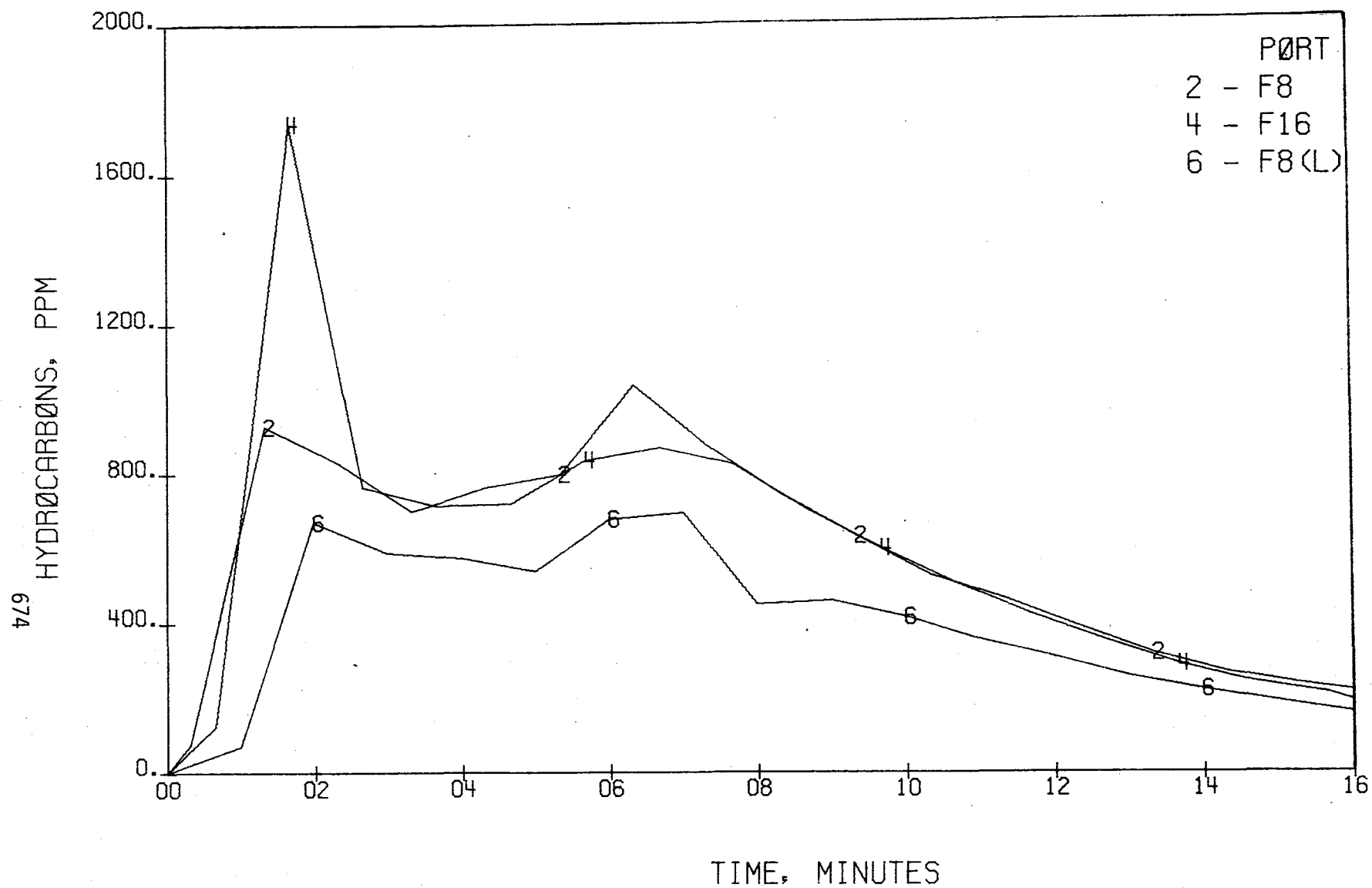


FIGURE 541 . - HYDROCARBONS CONCENTRATIONS, FØRE  
TEST 23

TEST 24

---

COVERED URETHANE FOAM SEATS & WALL, PSU,  
BIN, AND CEILING PANELS

TEST 24

COVERED URETHANE FOAM SEATS & WALL, PSU,  
BIN, AND CEILING PANELS

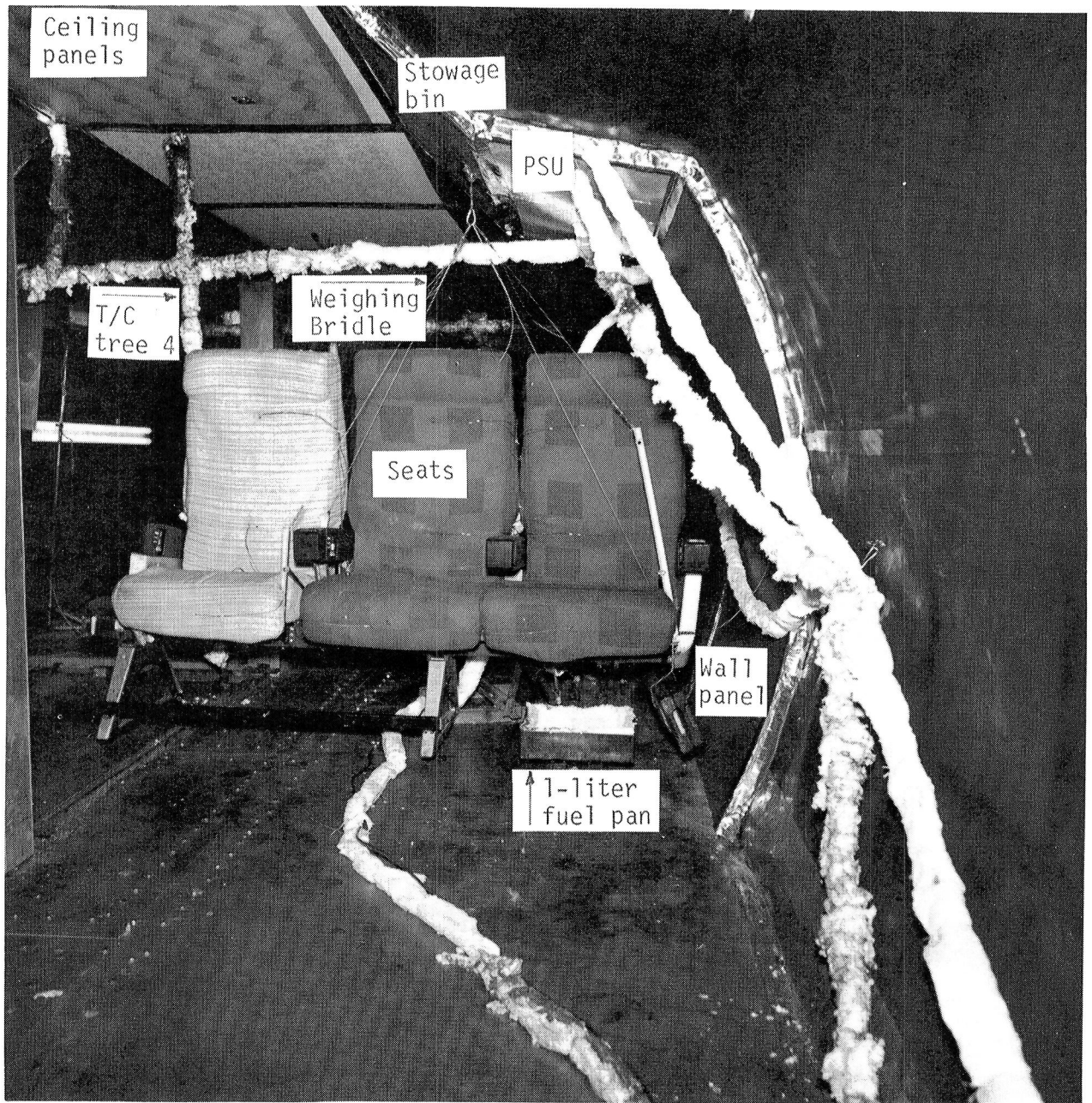


FIGURE 542. - PRE-TEST CONFIGURATION(FRONT VIEW), TEST 24



FIGURE 543 . - POST-TEST CONFIGURATION (FRONT VIEW), TEST 24



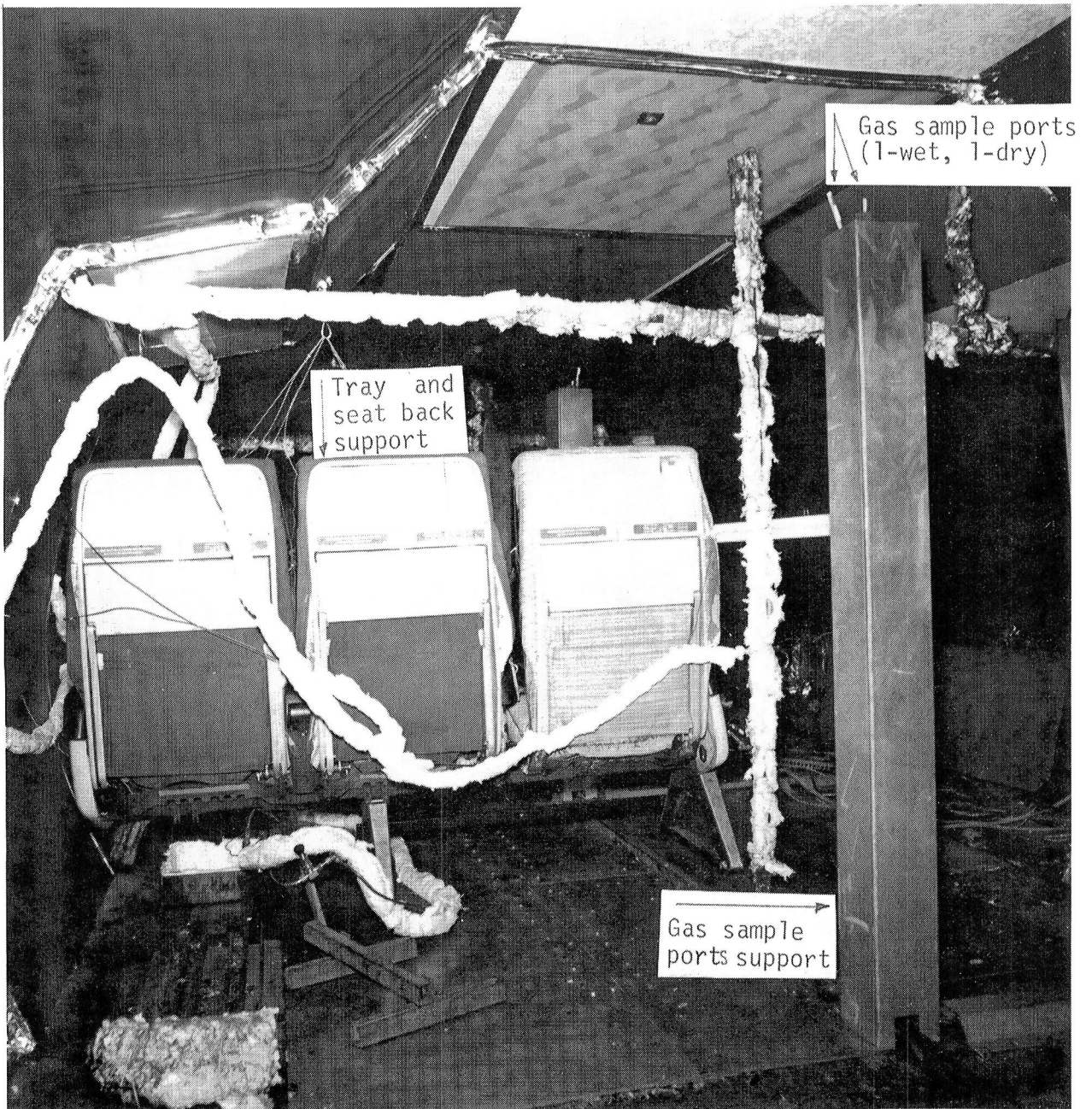


FIGURE 544 . - PRE-TEST CONFIGURATION(REAR VIEW), TEST 24



FIGURE 545 . - POST-TEST CONFIGURATION (REAR VIEW), TEST 24



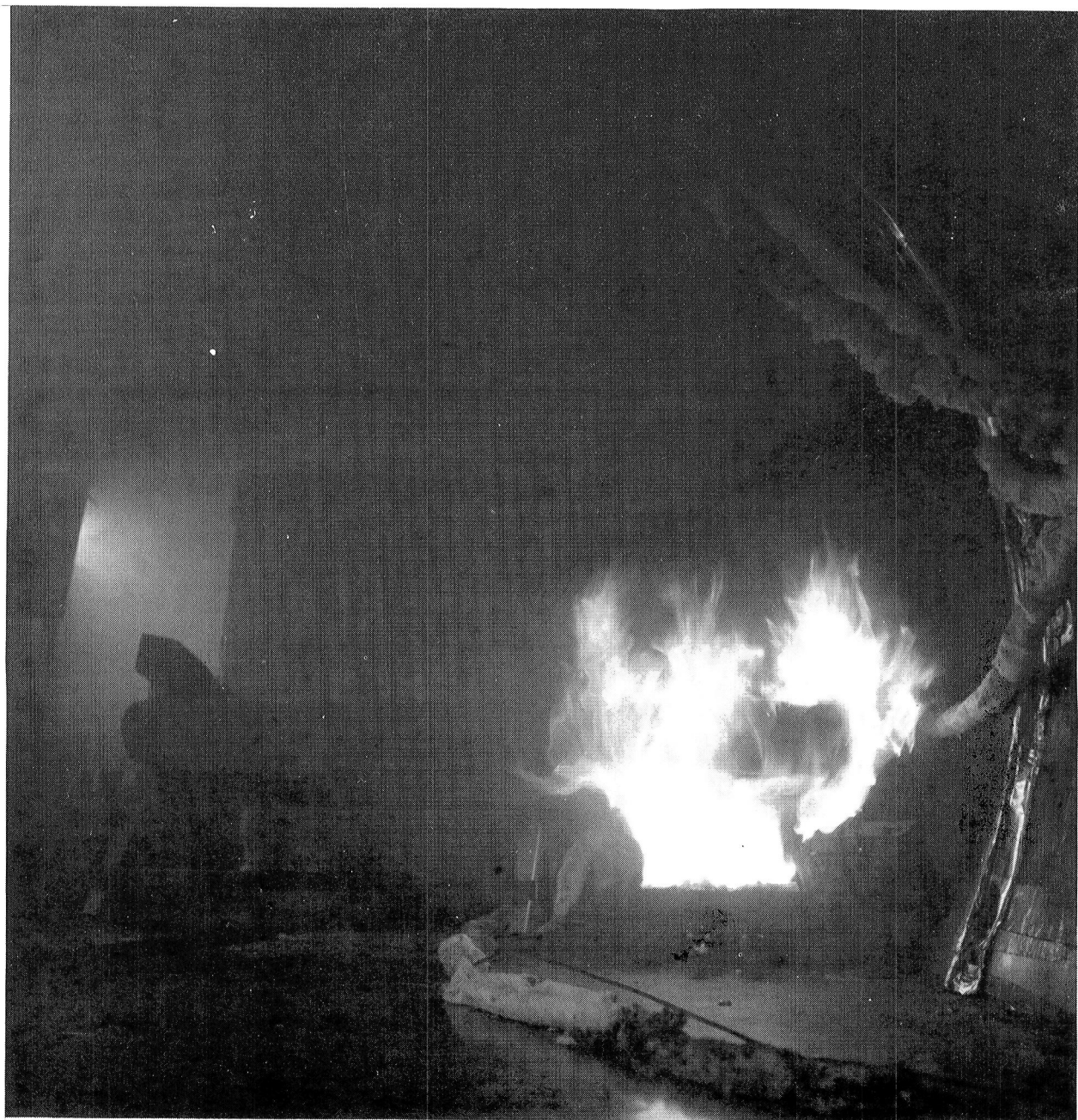


FIGURE 546 . - FIRE DURING TEST 24



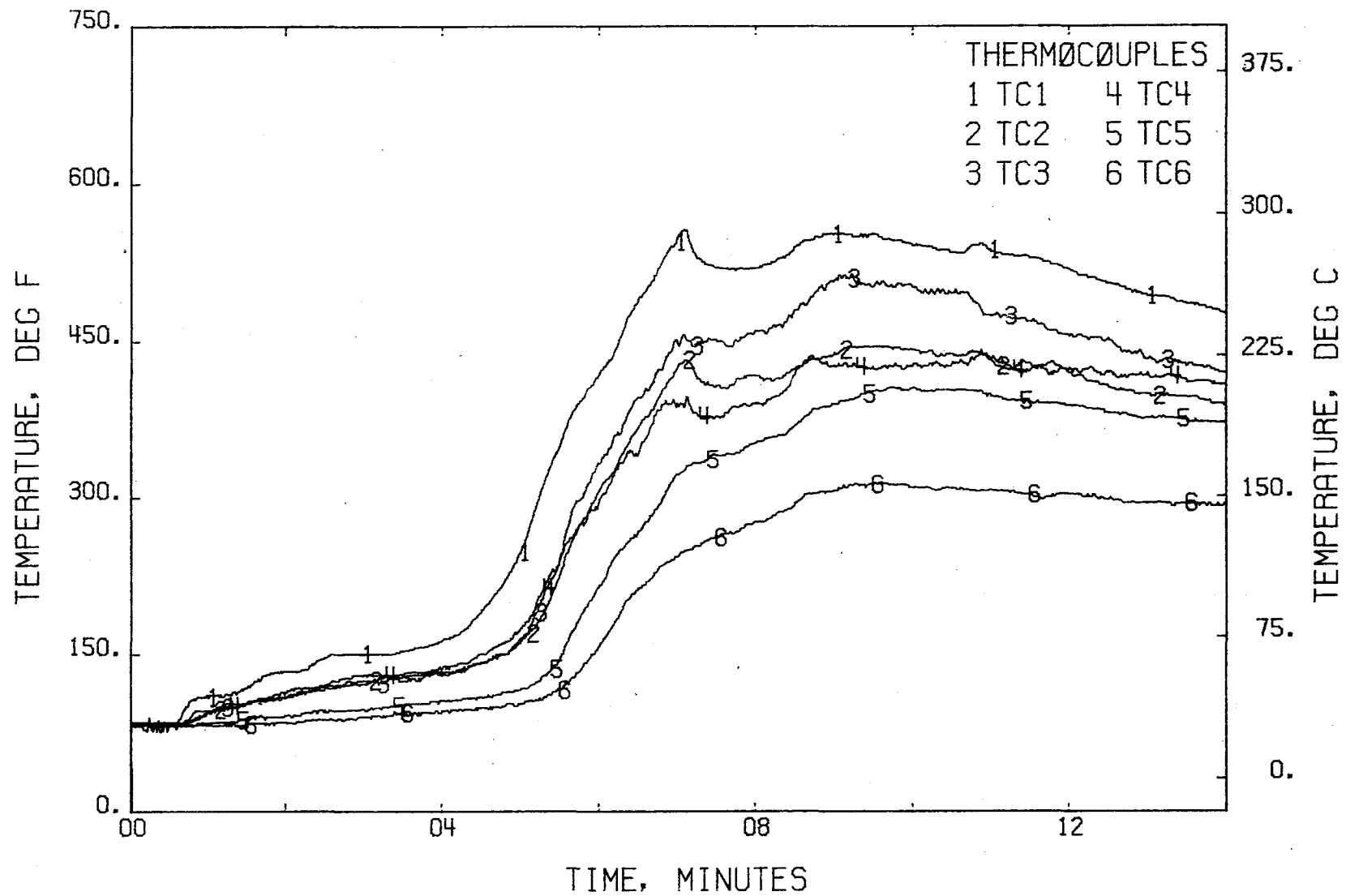


FIGURE 547 . - TEMPERATURES, T/C TREE 1  
TEST 24

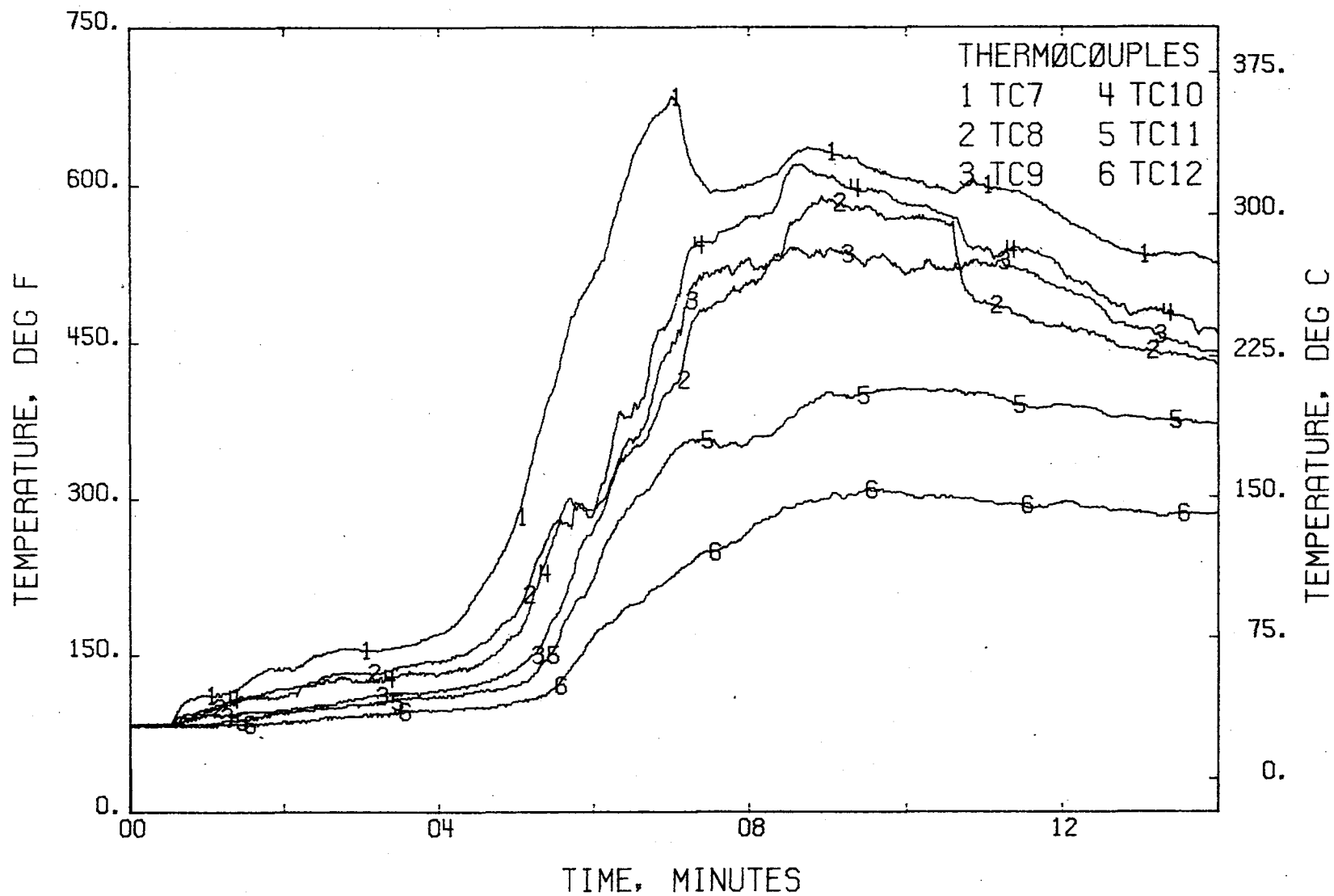


FIGURE 548 . - TEMPERATURES, T/C TREE 2  
TEST 24

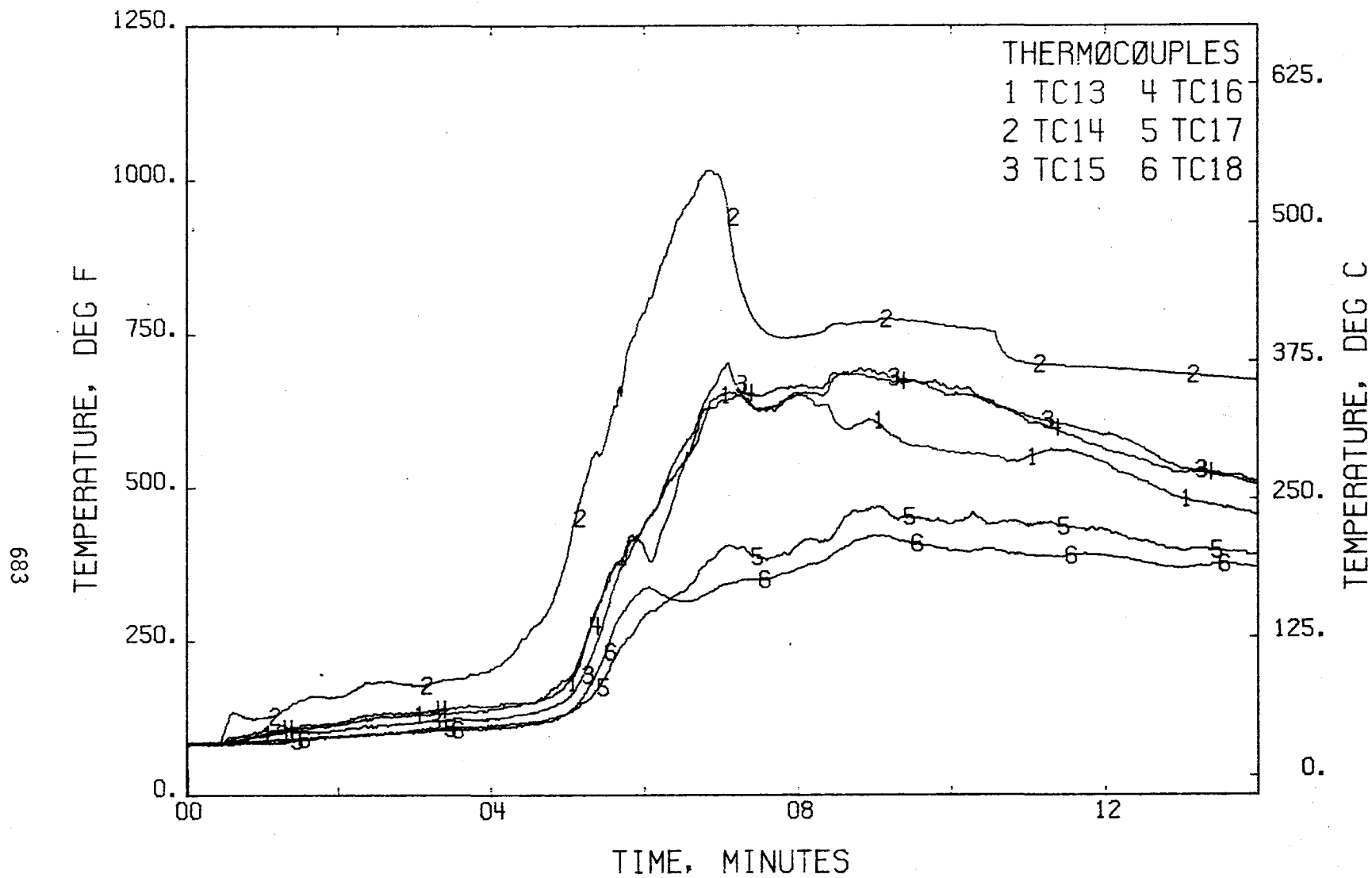


FIGURE 549 . - TEMPERATURES, T/C TREE 3  
TEST 24

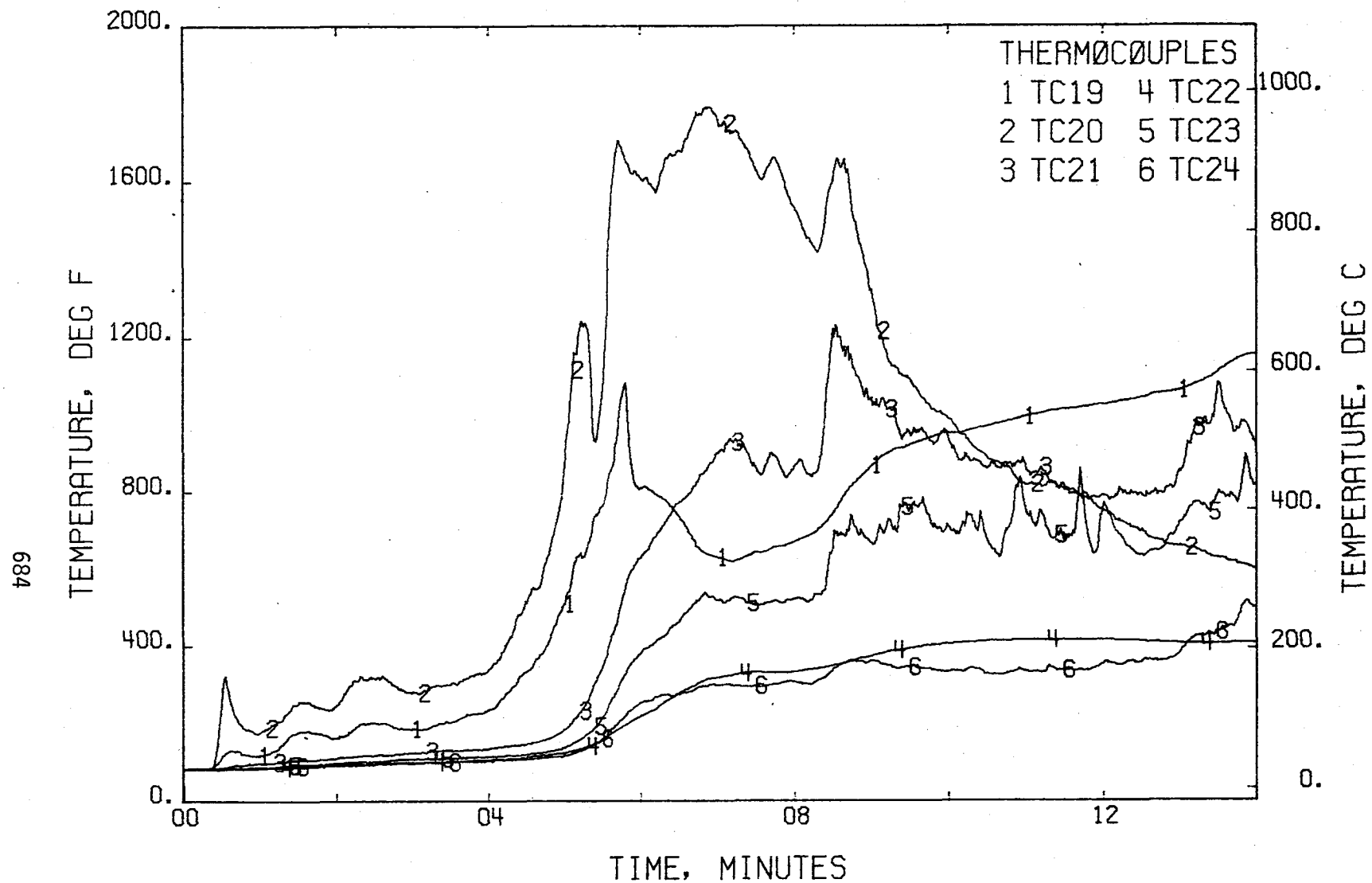


FIGURE 550 . - TEMPERATURES, T/C TREE 4  
TEST 24

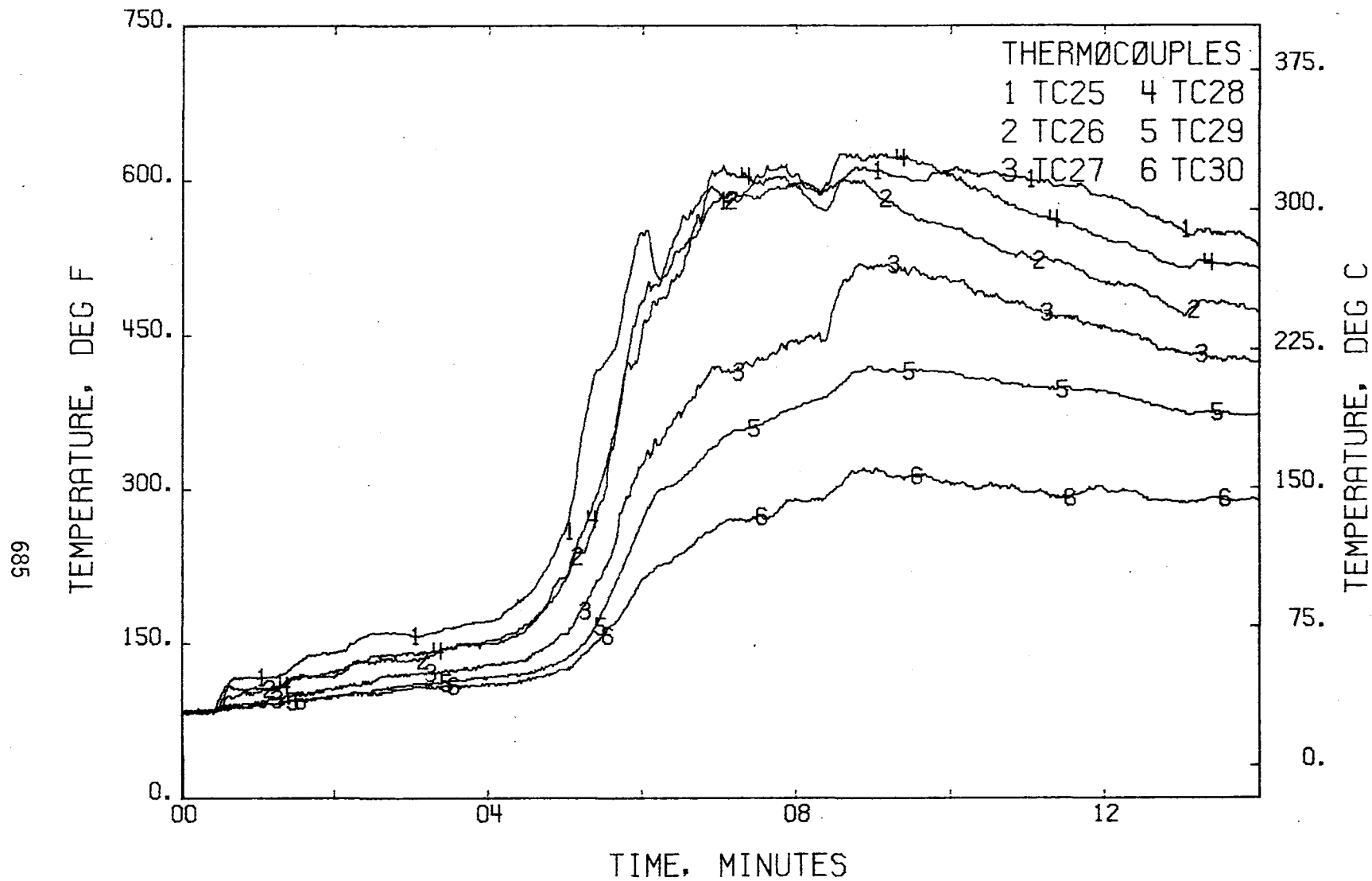


FIGURE 551 . - TEMPERATURES, T/C TREE 5  
TEST 24

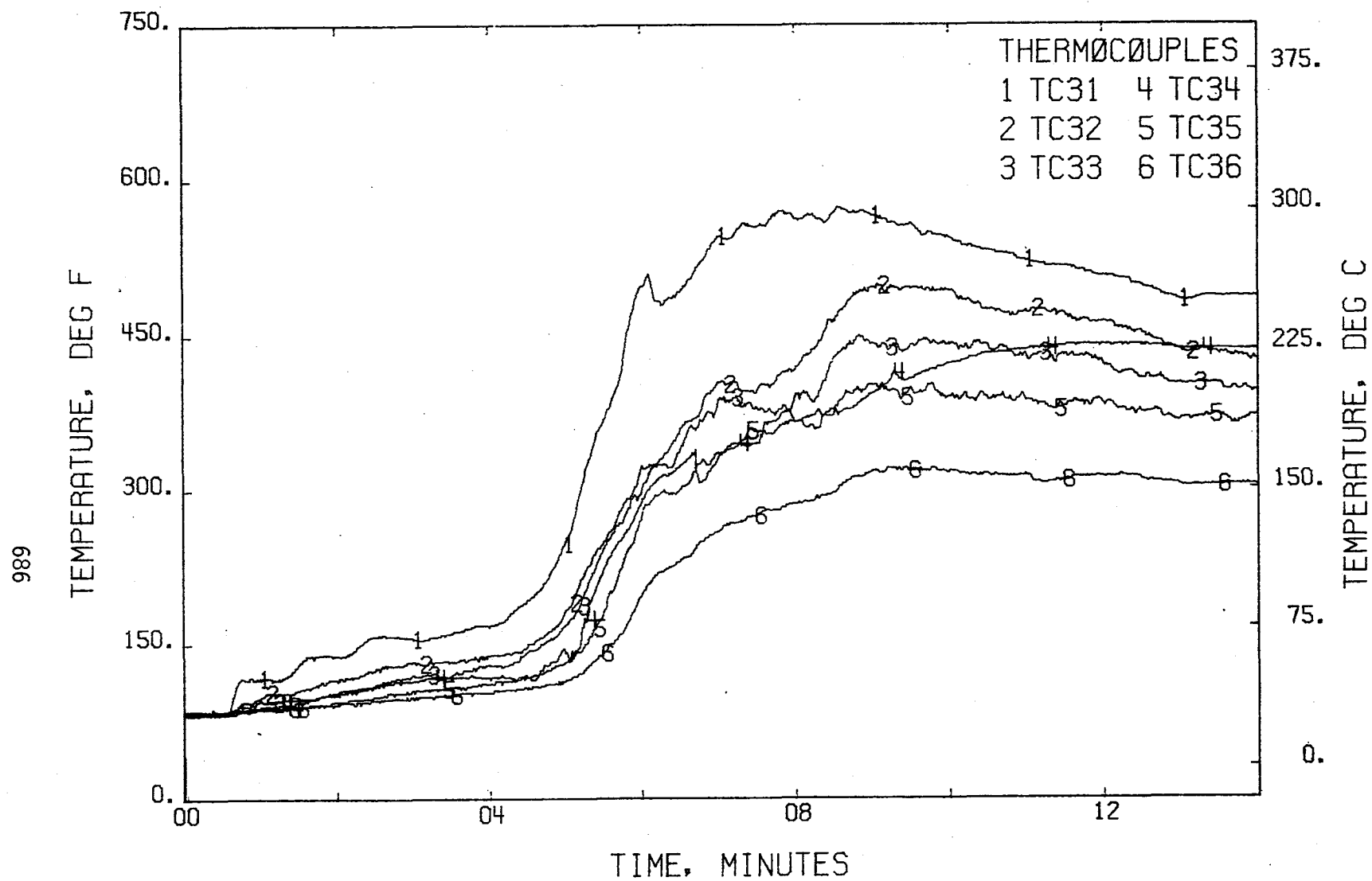


FIGURE 552 . - TEMPERATURES, T/C TREE 6  
TEST 24

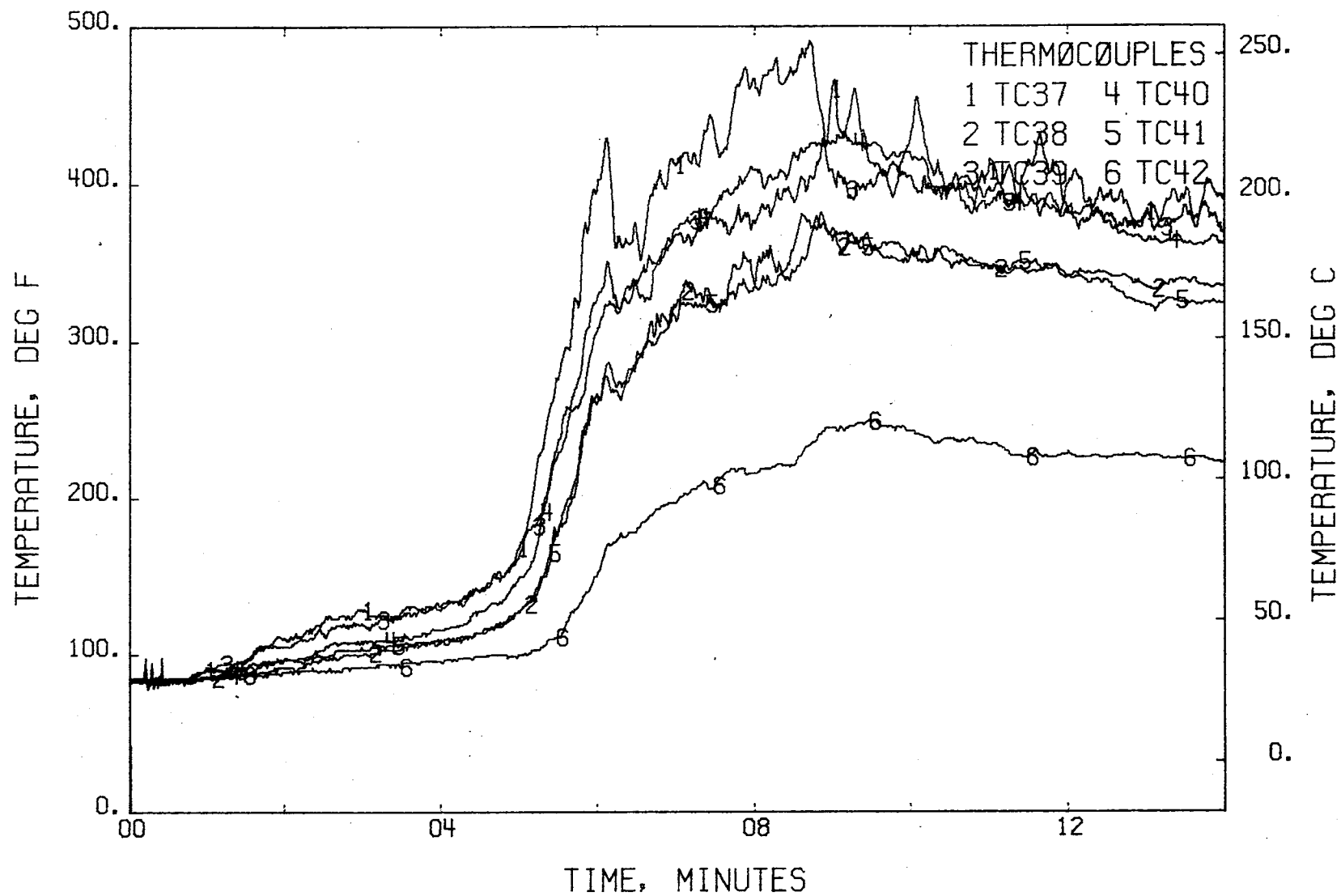


FIGURE 553 . - TEMPERATURES, T/C TREE 7  
TEST 24

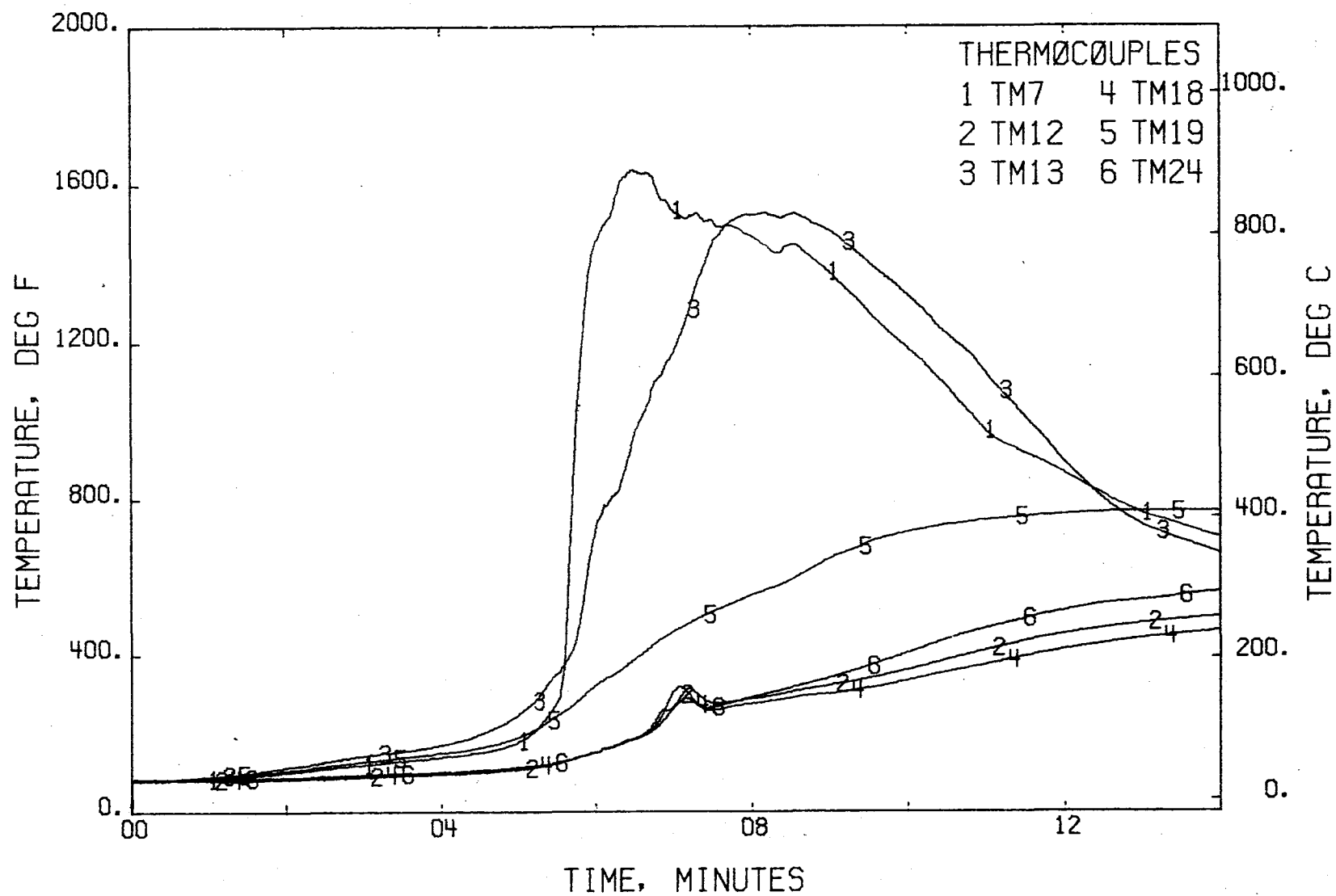


FIGURE 554 . - TEMPERATURES, PSU  
TEST 24



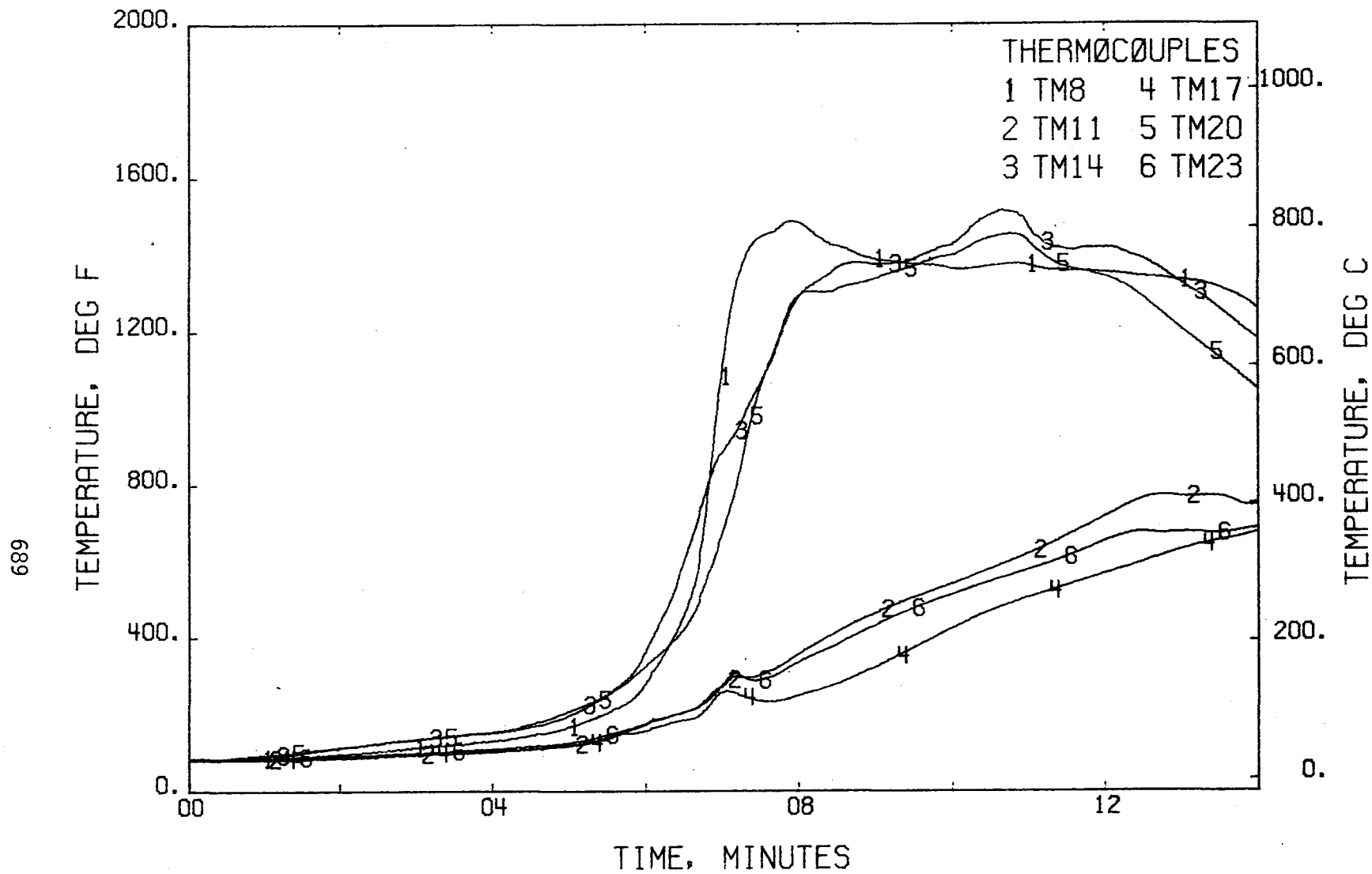


FIGURE 555 . - TEMPERATURES, STORAGE BINS  
TEST 24

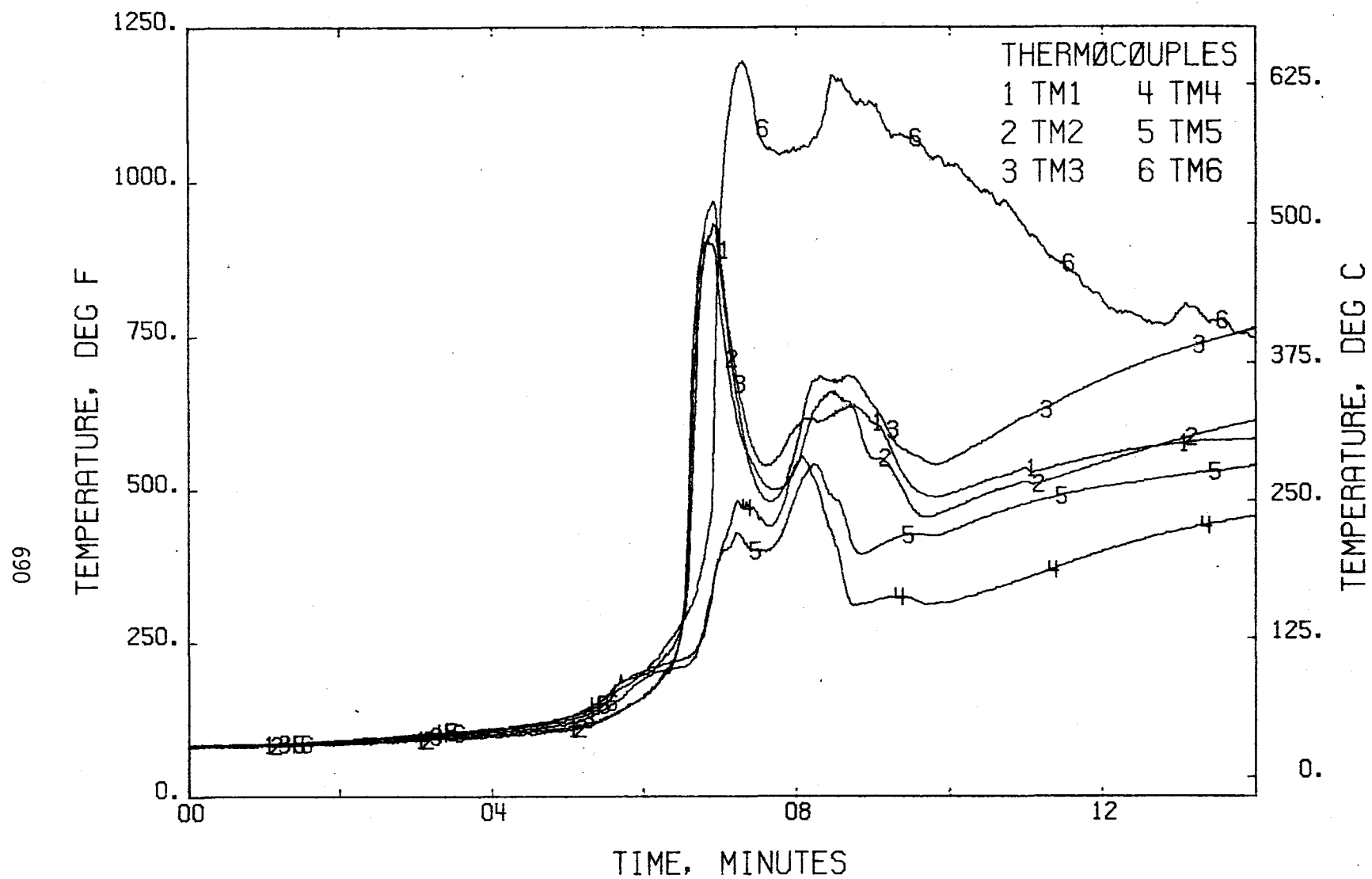


FIGURE 556 . - TEMPERATURES, CEILING PANELS (AFT)  
TEST 24

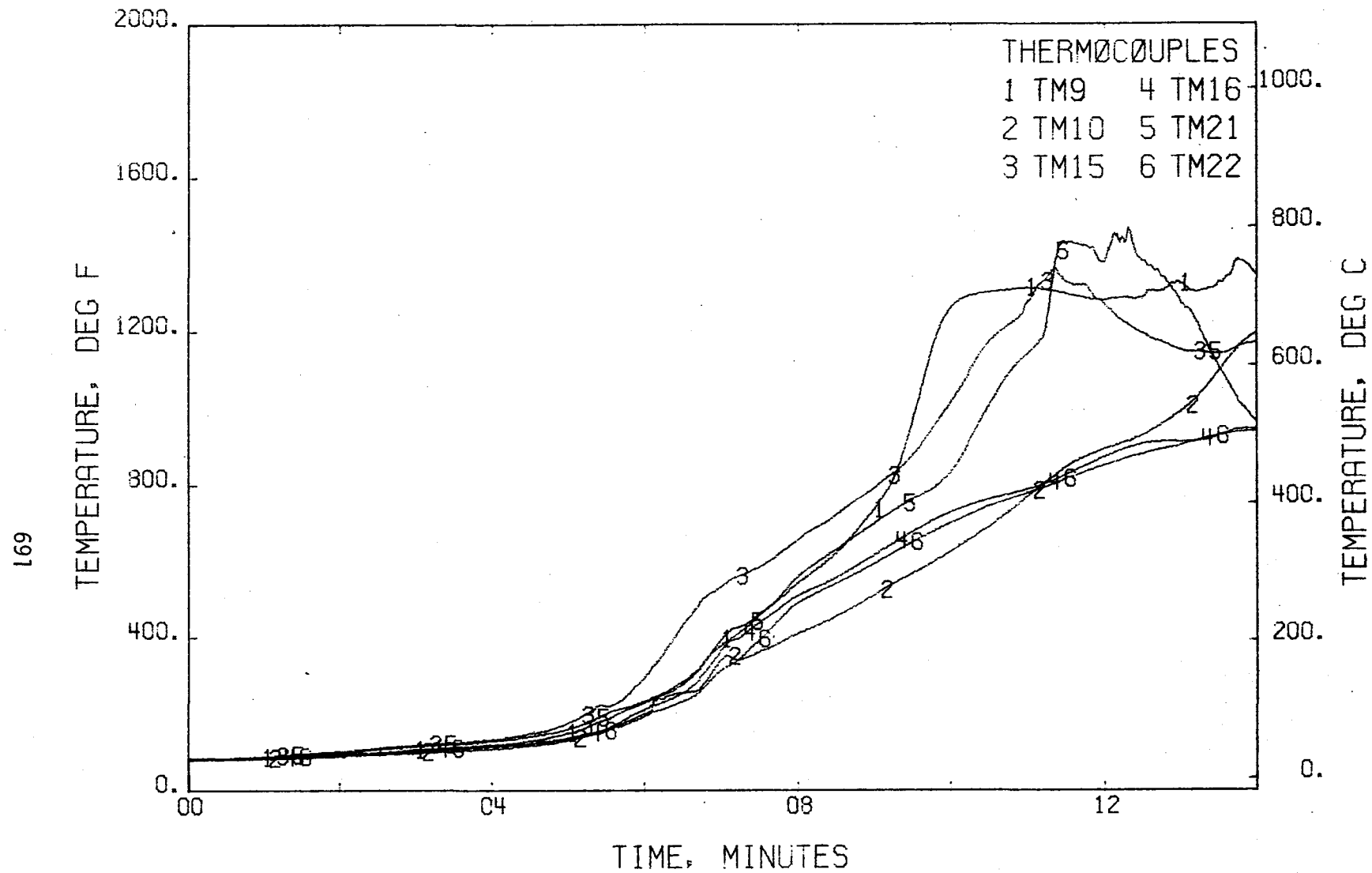


FIGURE 557 . - TEMPERATURES, CEILING PANEL (CENTER)  
TEST 24

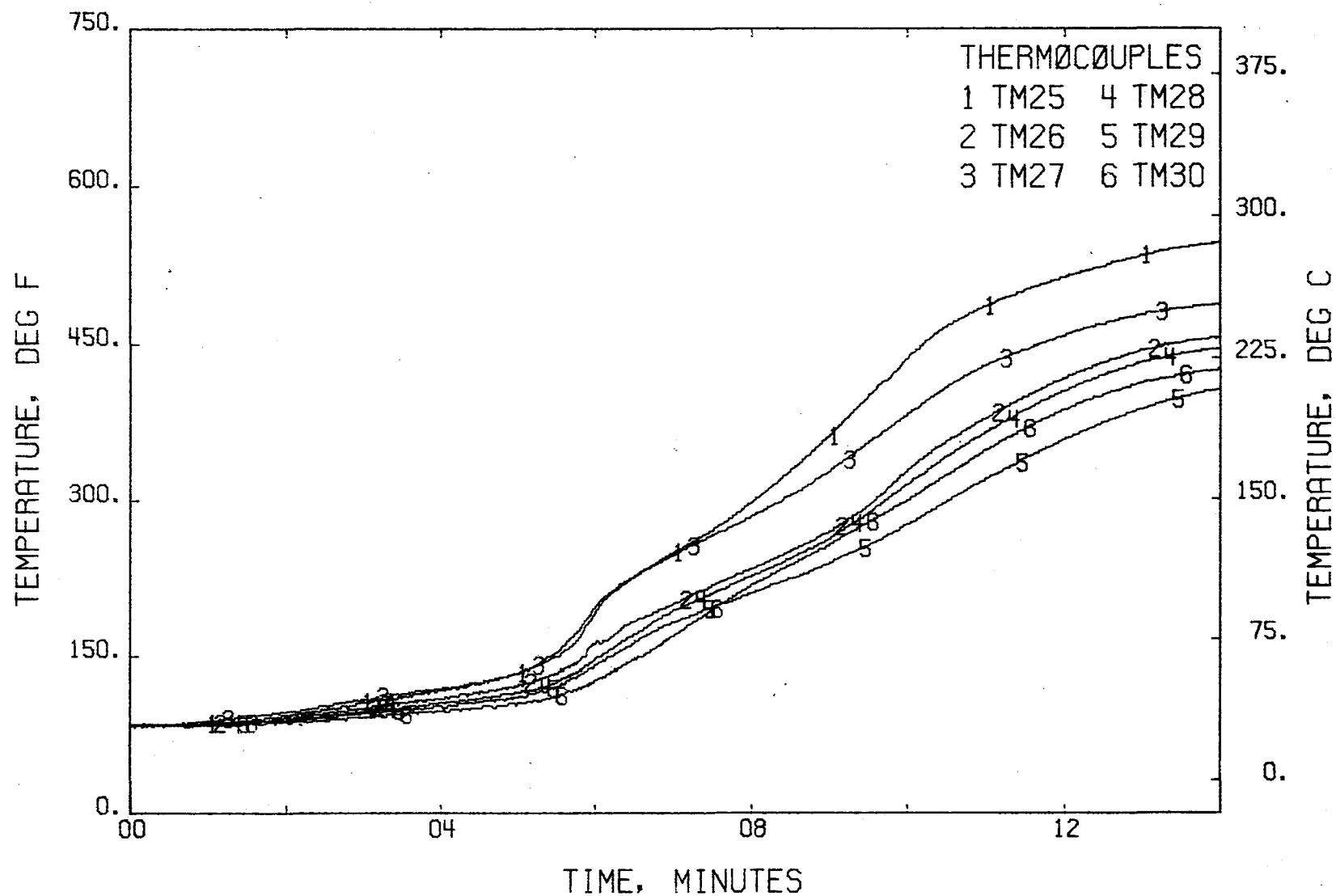


FIGURE 558 . - TEMPERATURES, CEILING PANELS (FORWARD)  
TEST 24

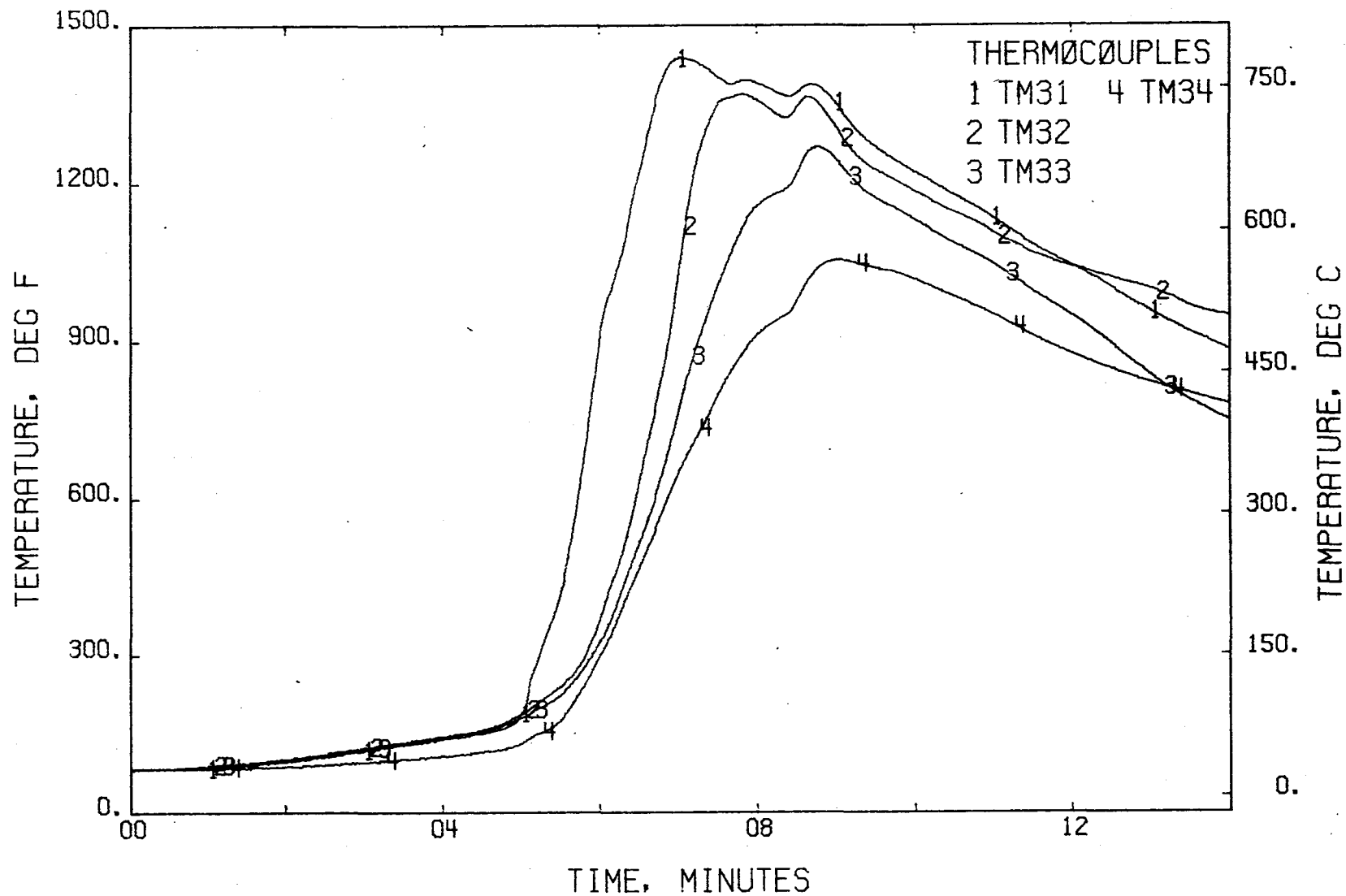


FIGURE 559 . - TEMPERATURES, SIDEWALL PANEL (TOP)  
 TEST 24

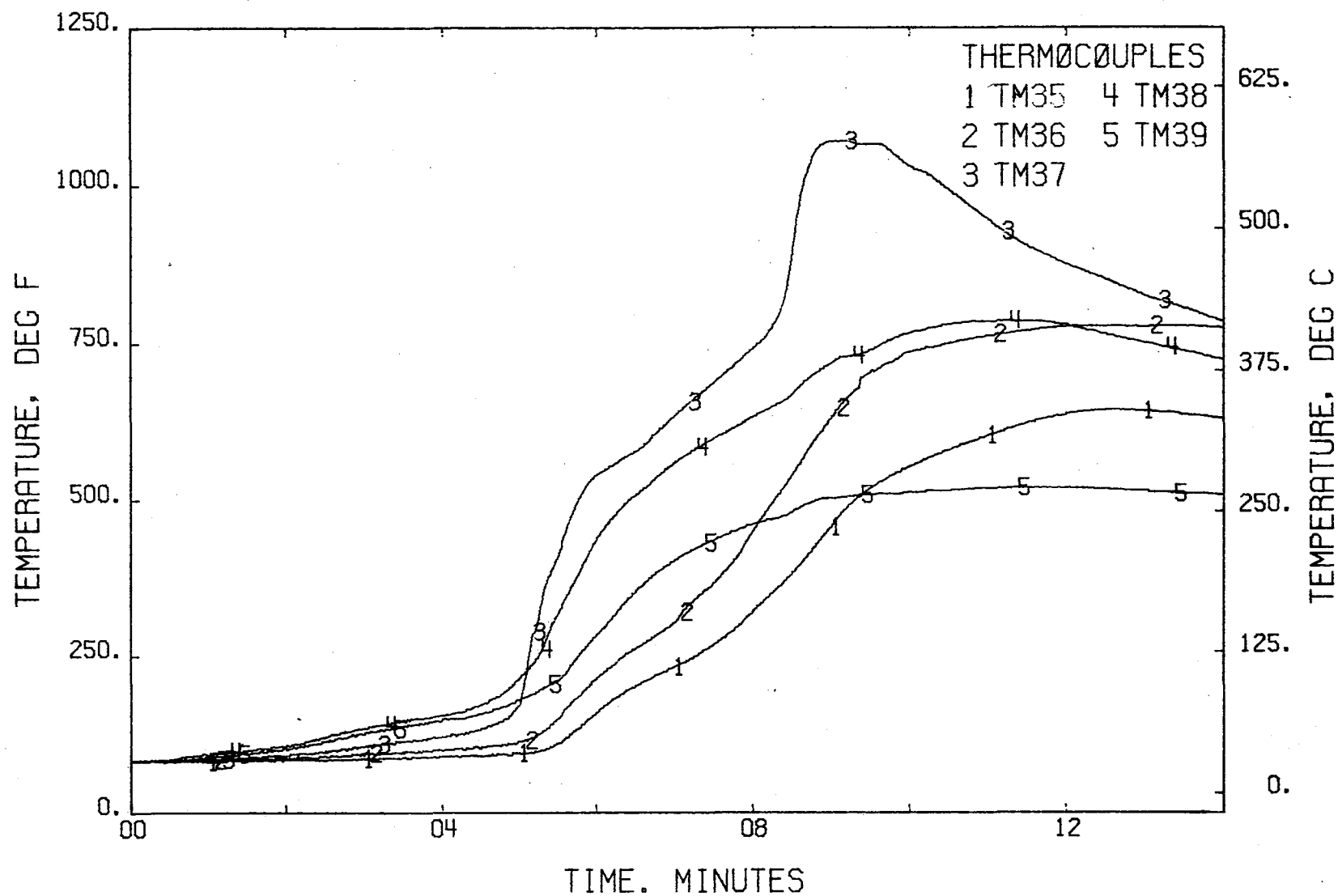


FIGURE 560 . - TEMPERATURES, SIDEWALL PANEL (CENTER)  
TEST 24

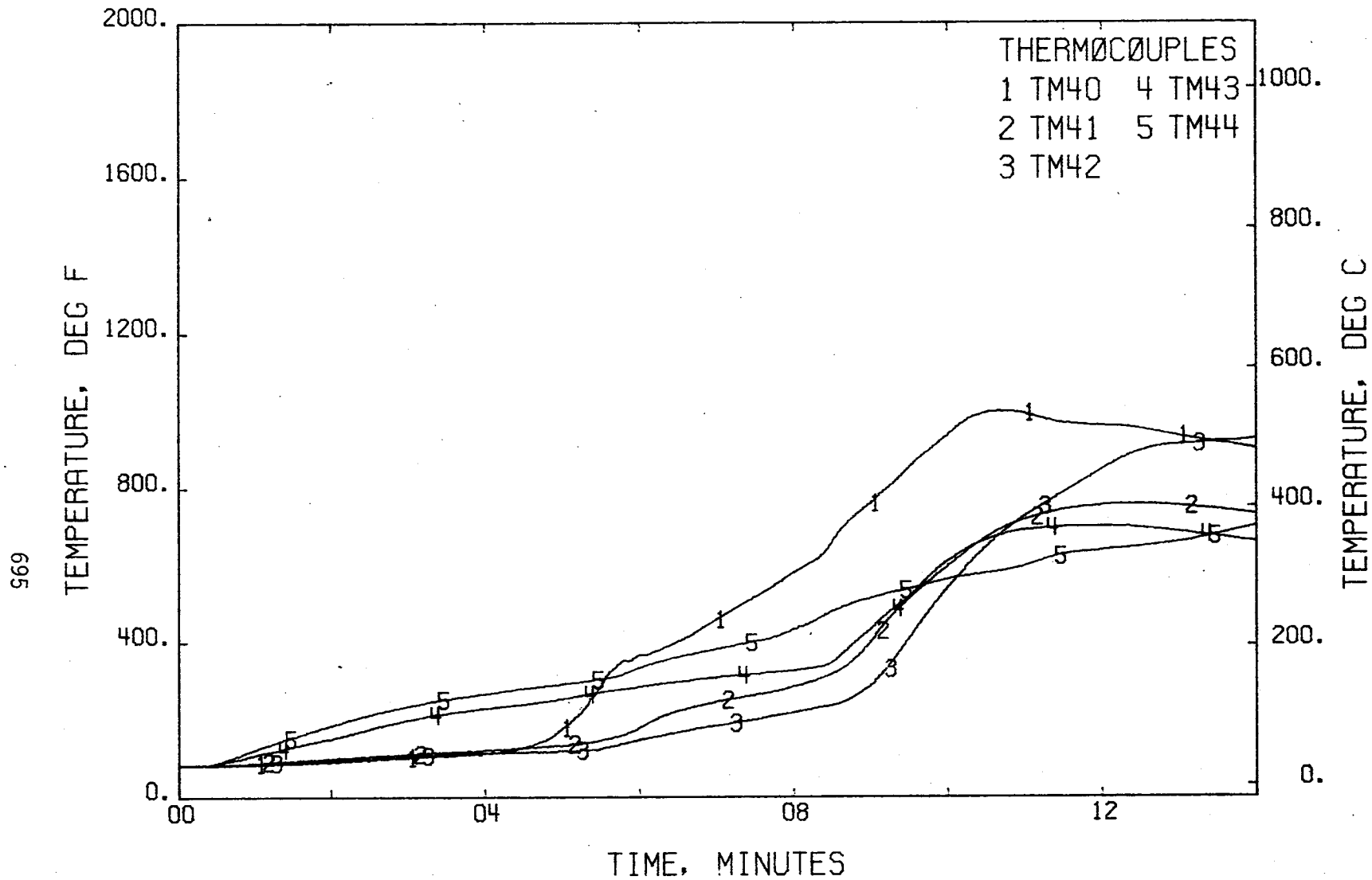


FIGURE 561 . - TEMPERATURES, SIDEWALL PANEL (BOTTOM).  
TEST 24

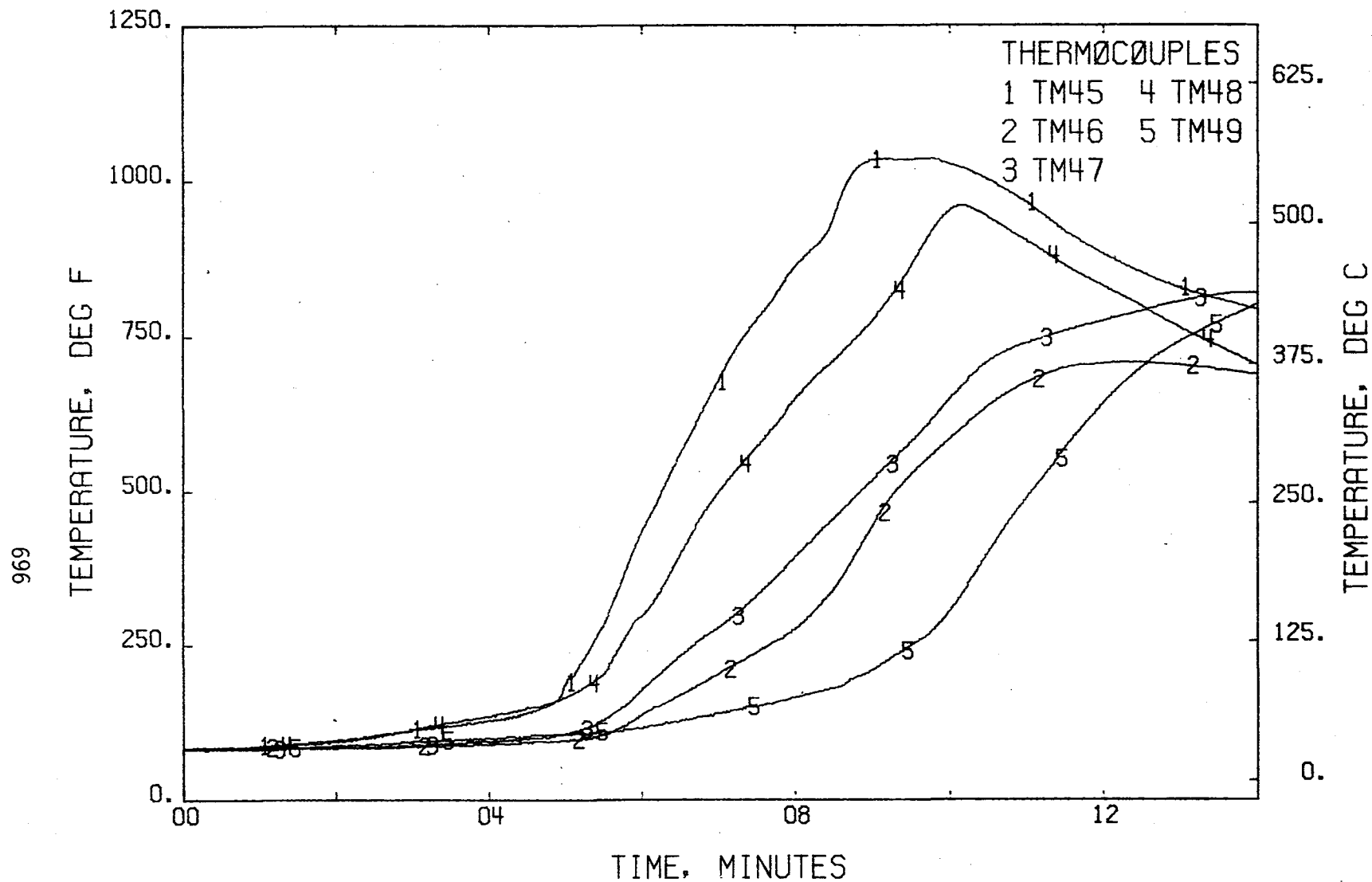


FIGURE 562 . - TEMPERATURES, SIDEWALL PANEL (REAR)  
TEST 24



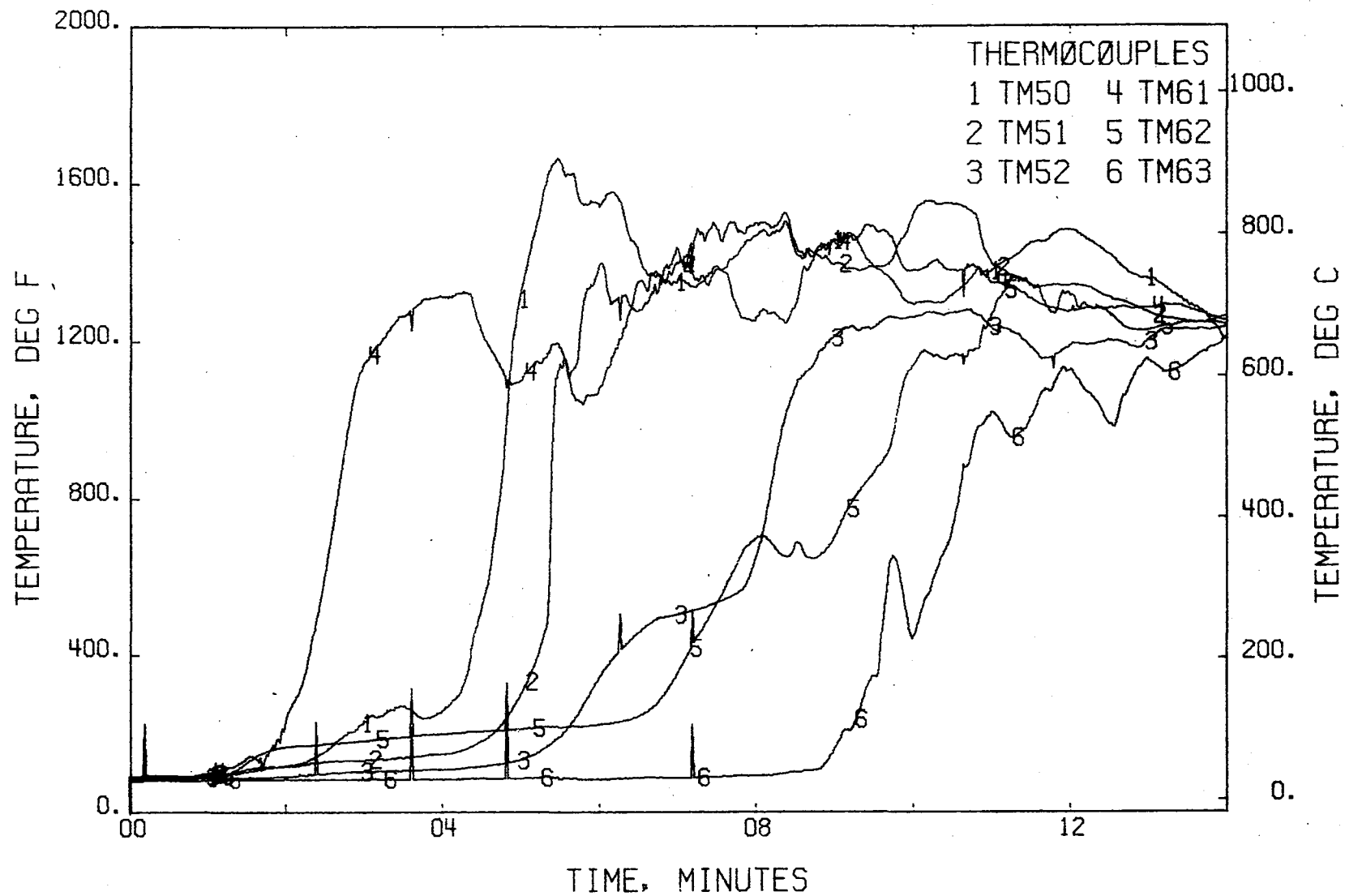


FIGURE 563 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 24

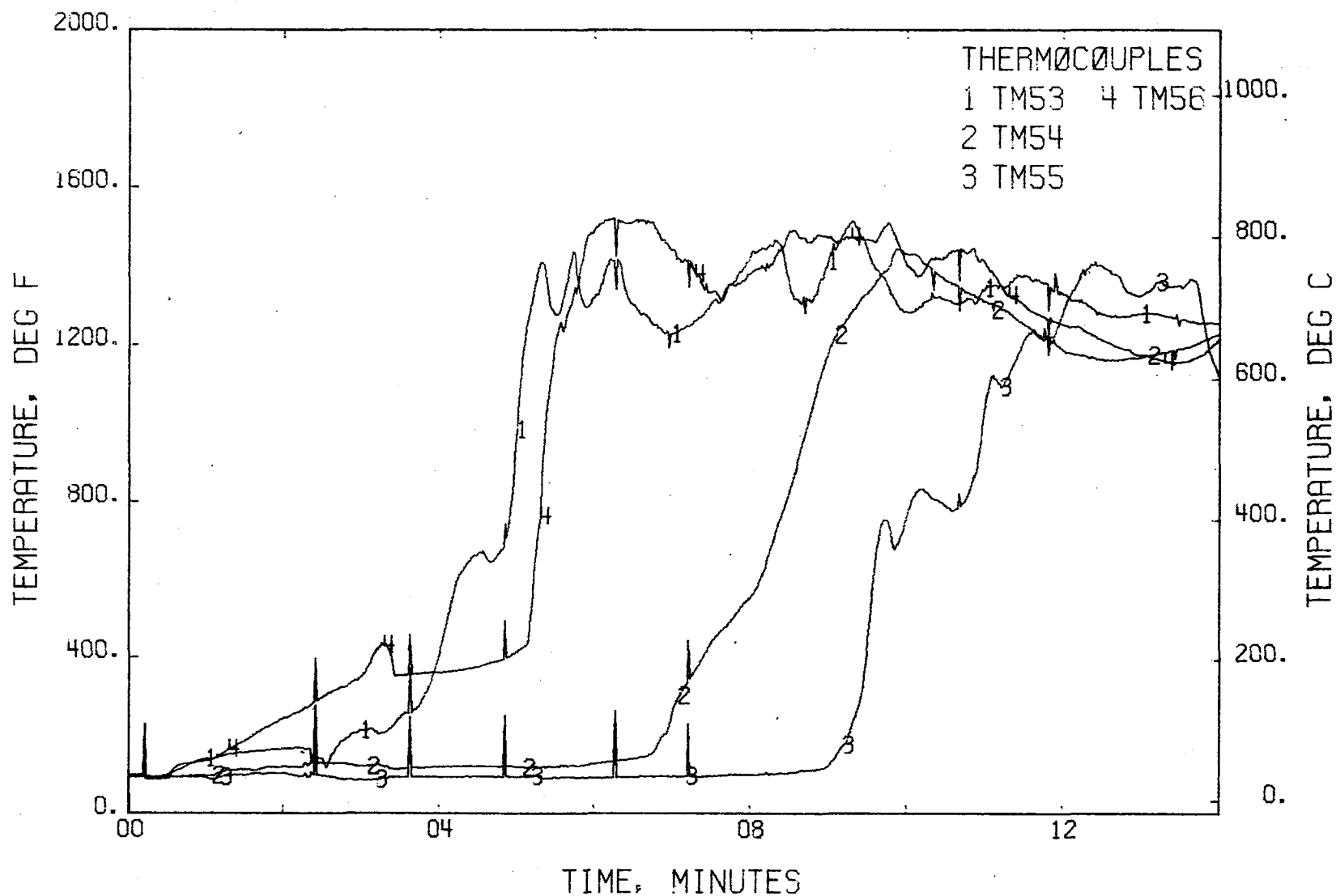


FIGURE 564 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 24

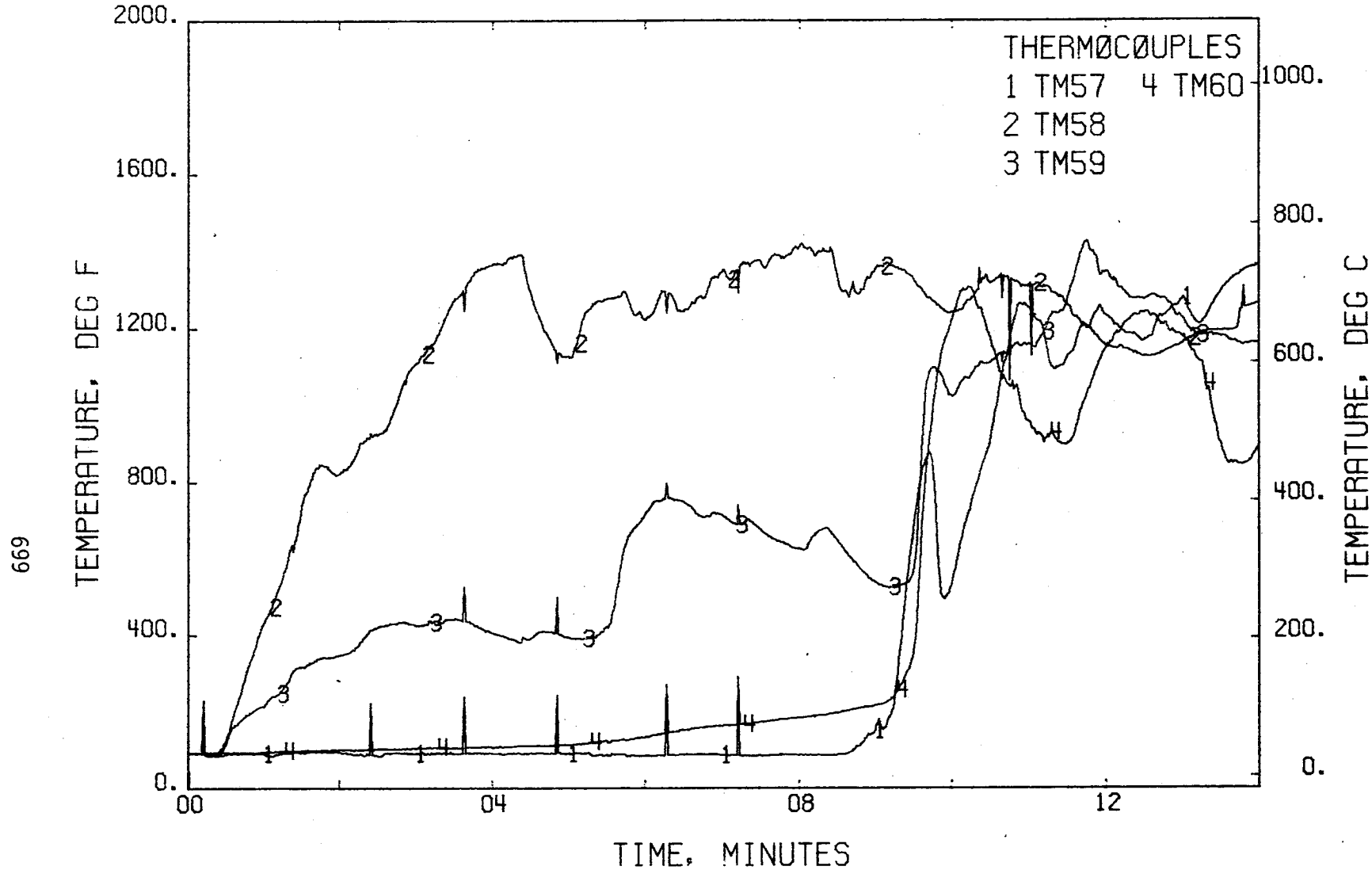


FIGURE 564 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 24

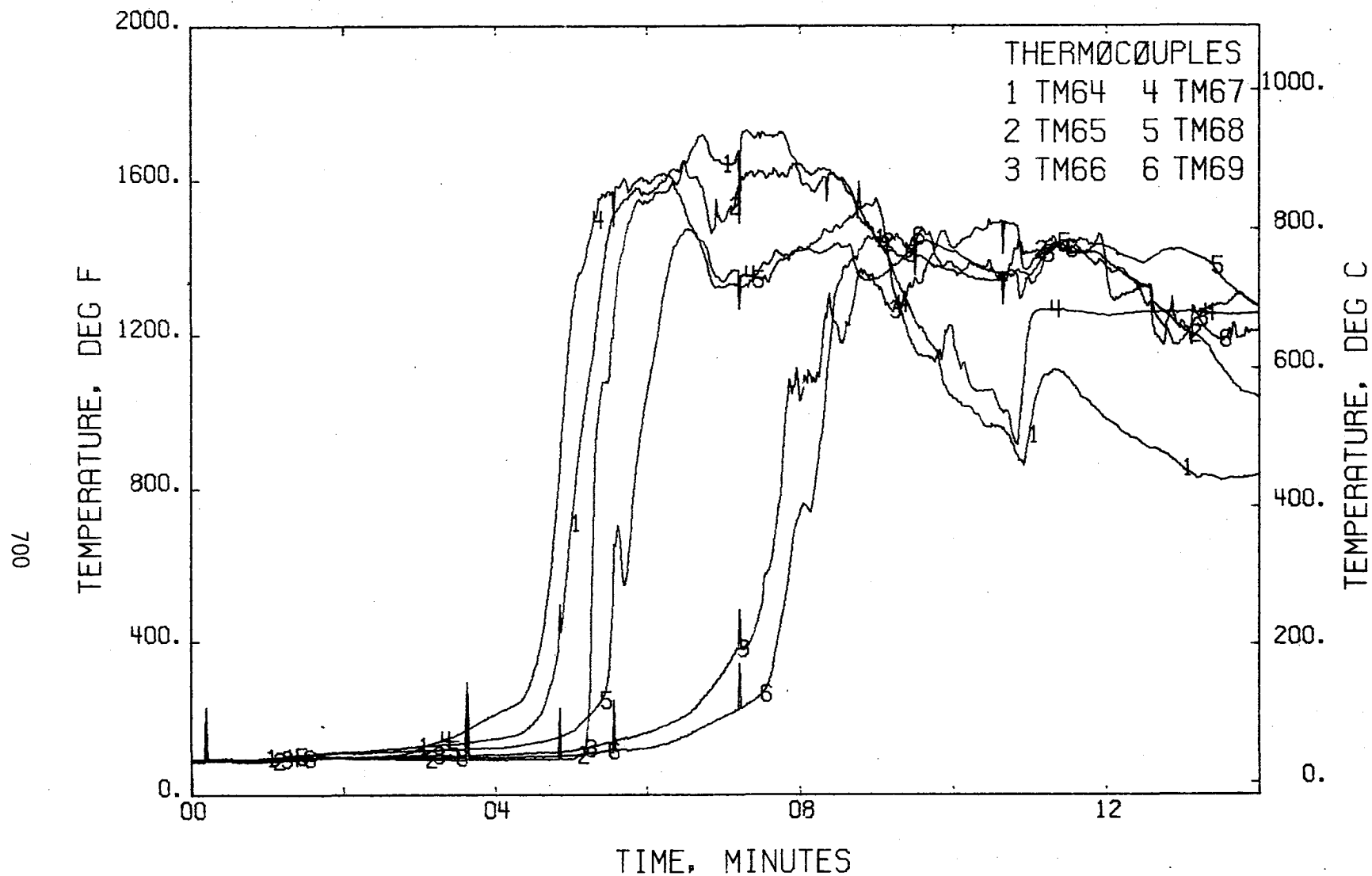


FIGURE 565 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 24

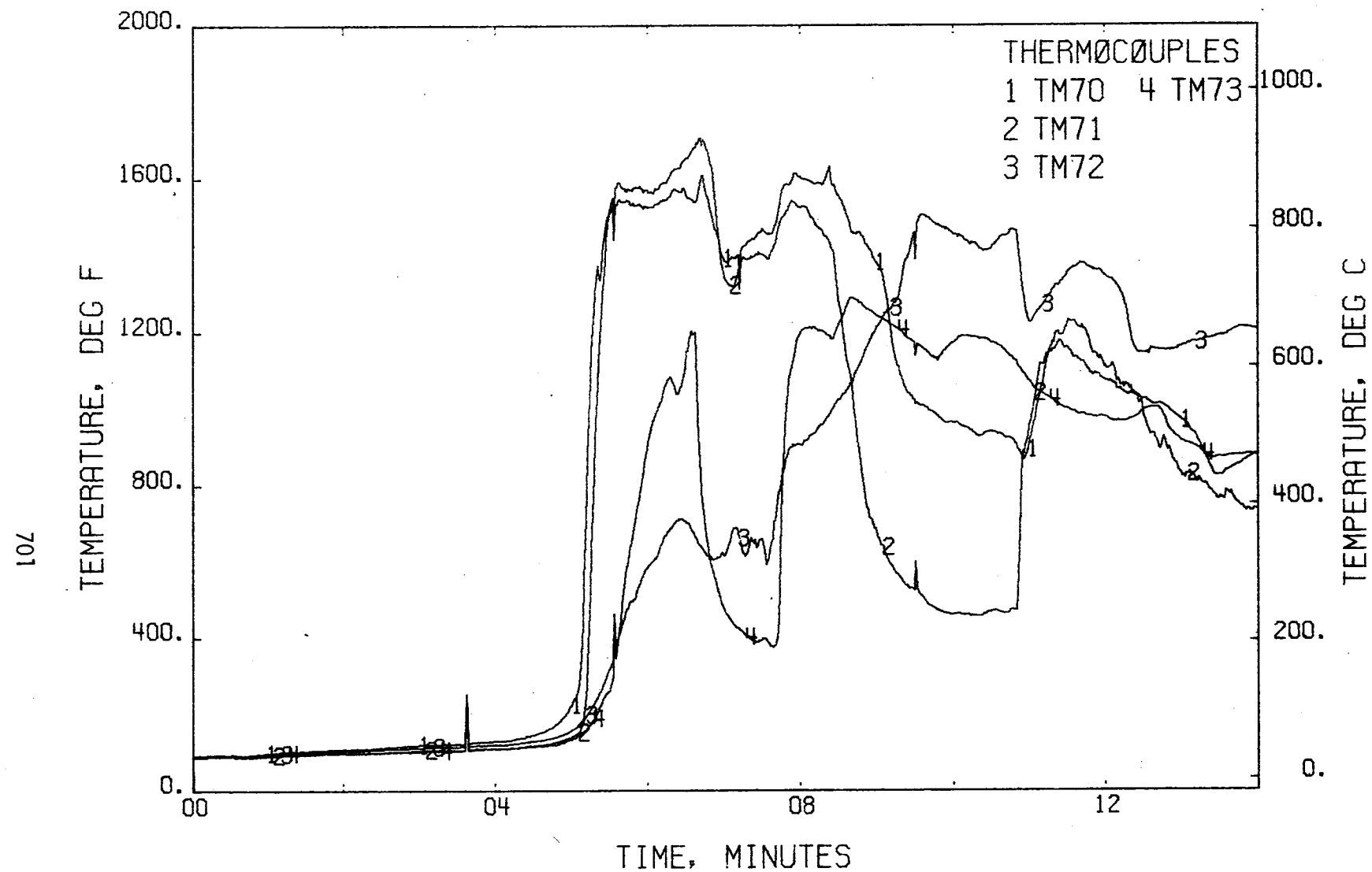


FIGURE 566 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 24

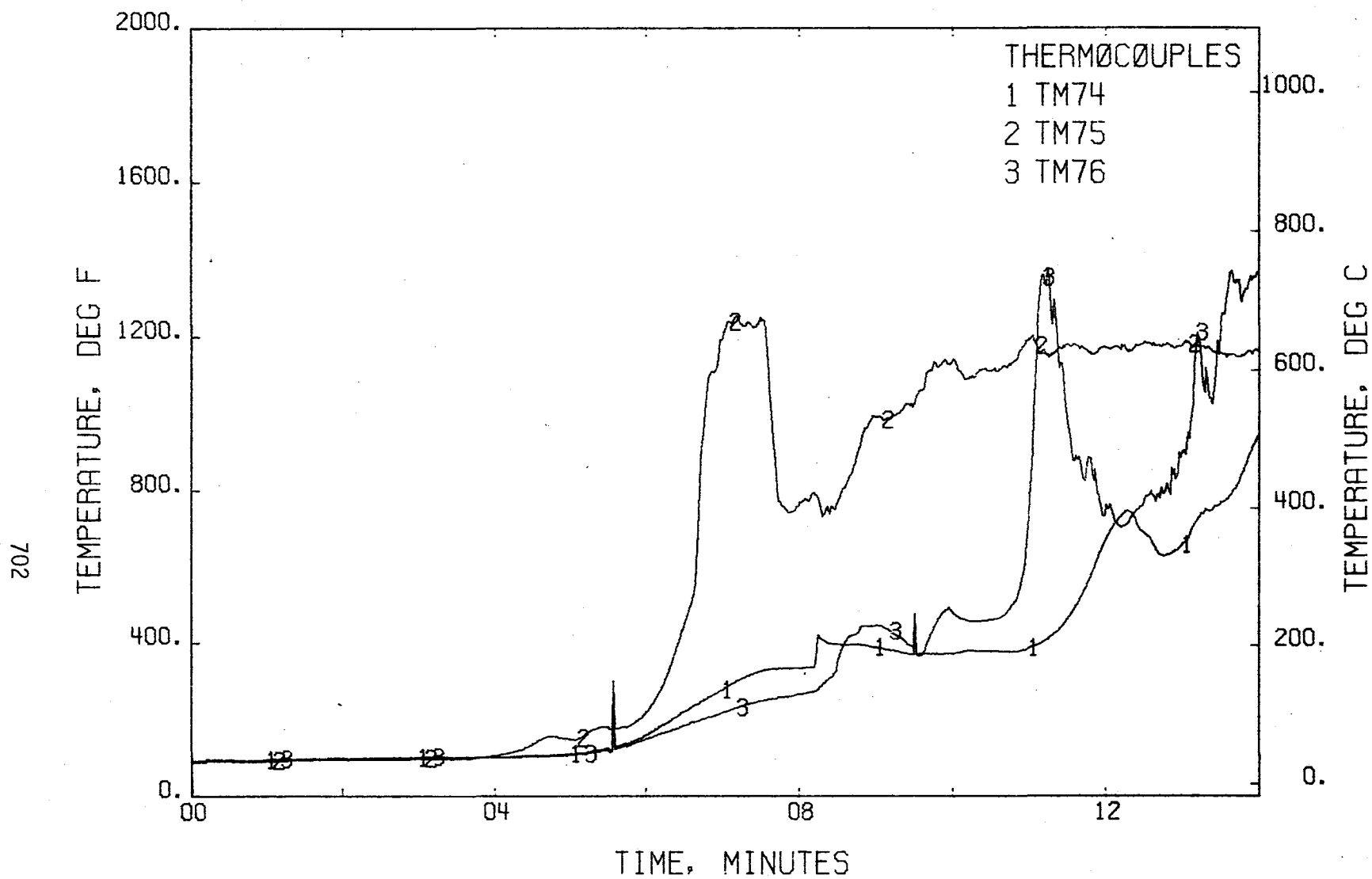


FIGURE 566 . - TEMPERATURES, SEAT BACK (EDGES)-CONT.  
TEST 24

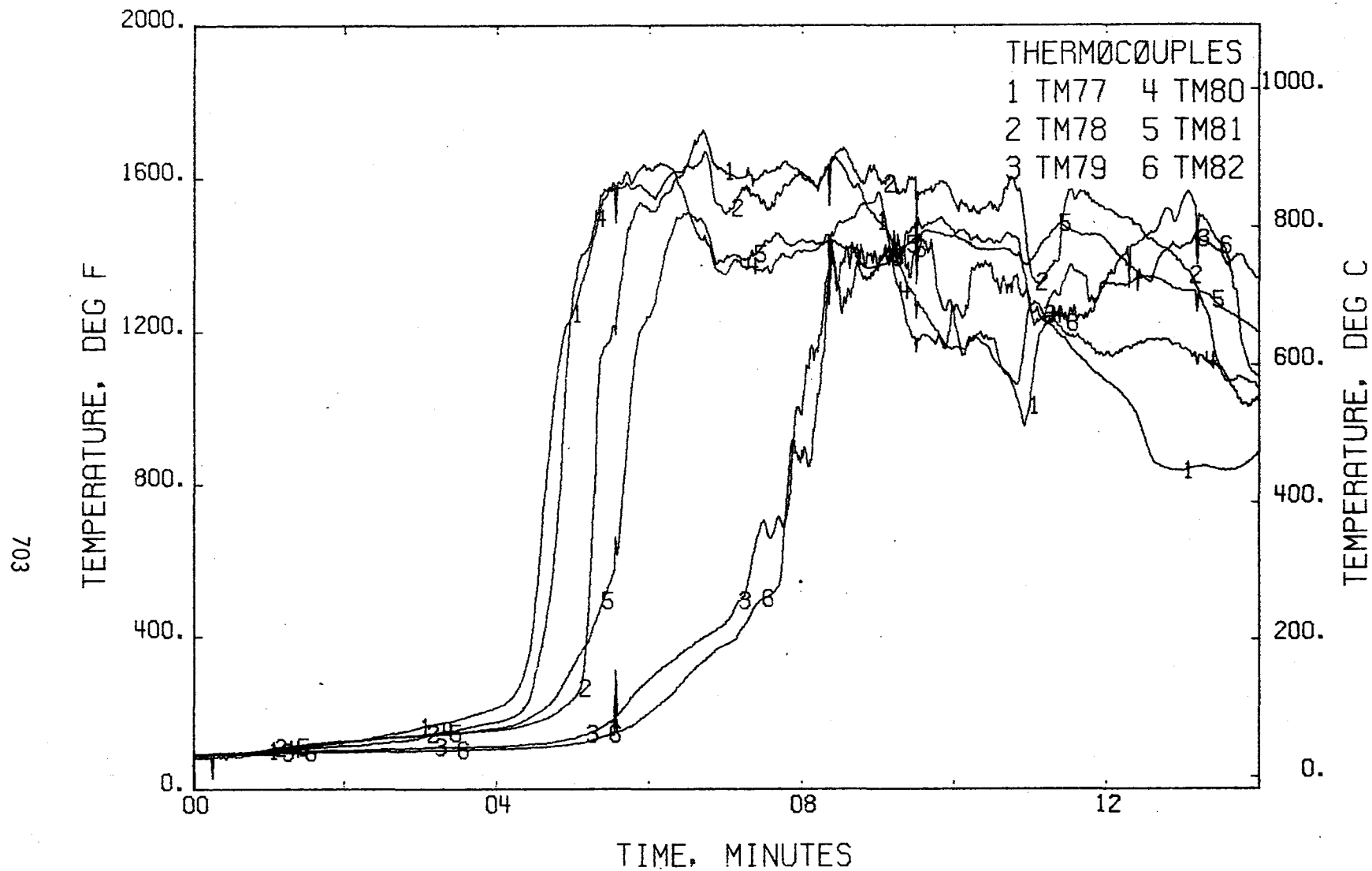


FIGURE 567 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 24

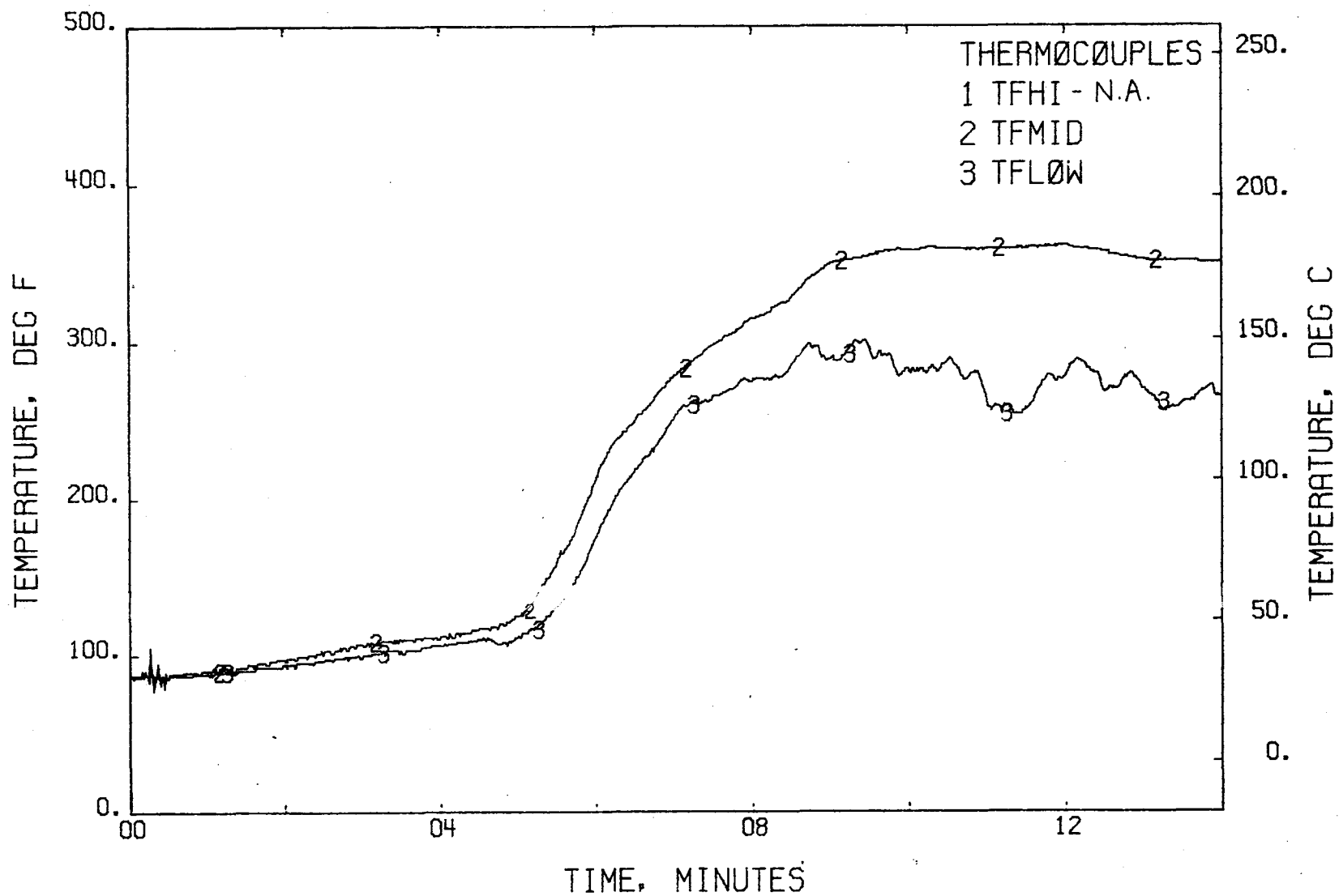


FIGURE 568 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 24



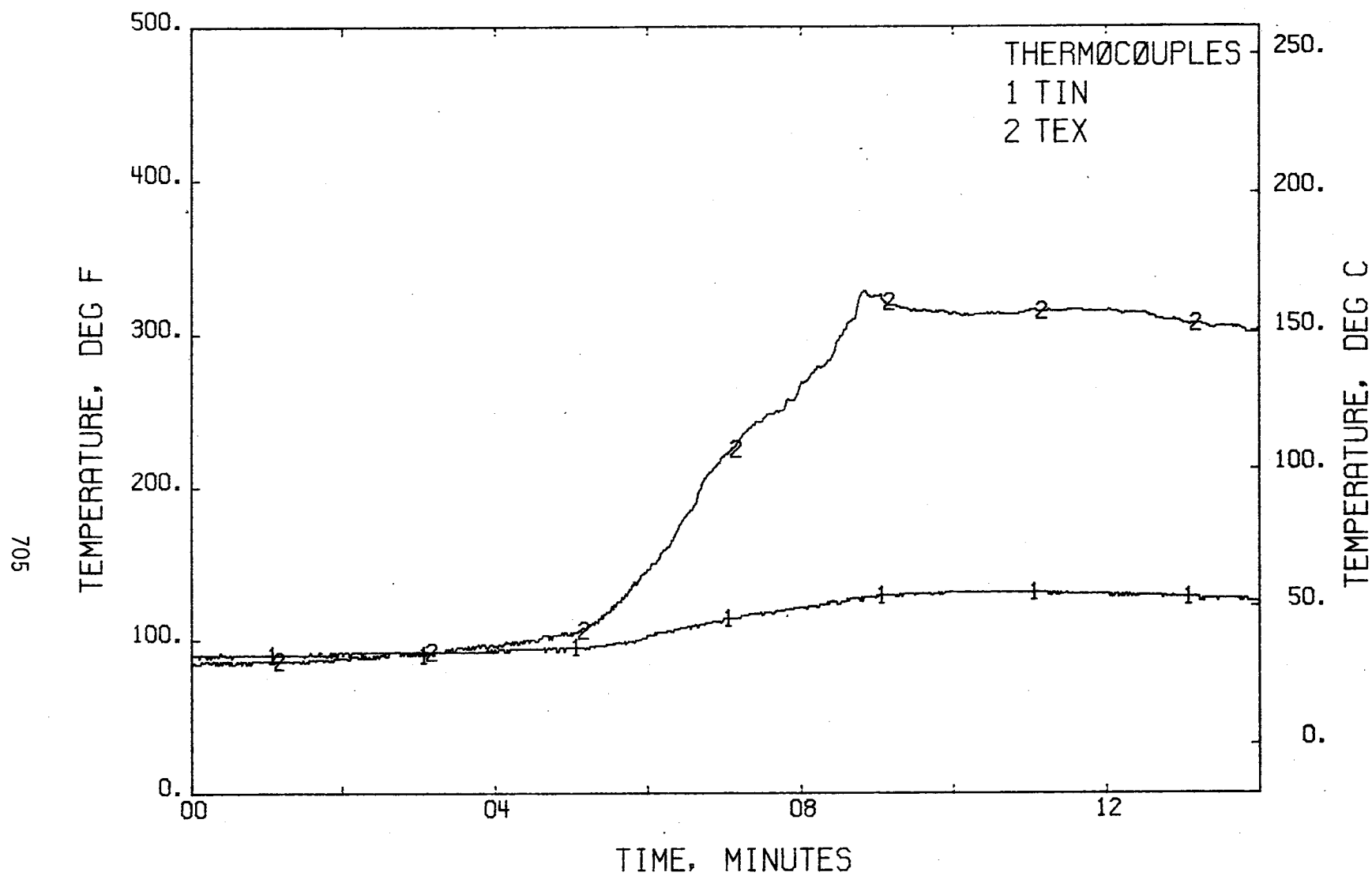


FIGURE 569 . - TEMPERATURES, INLET + EXIT  
TEST 24

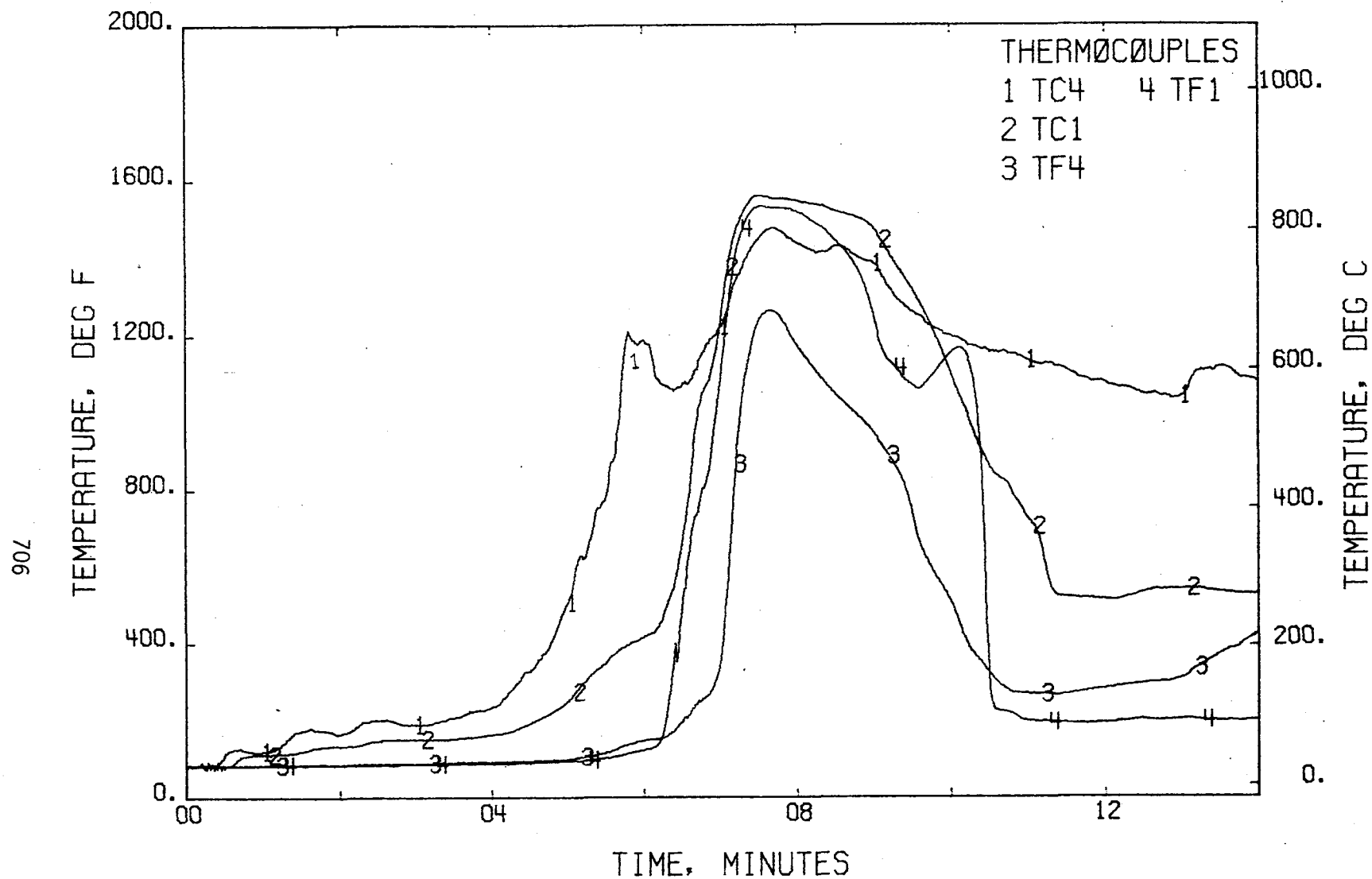


FIGURE 570 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 24

707

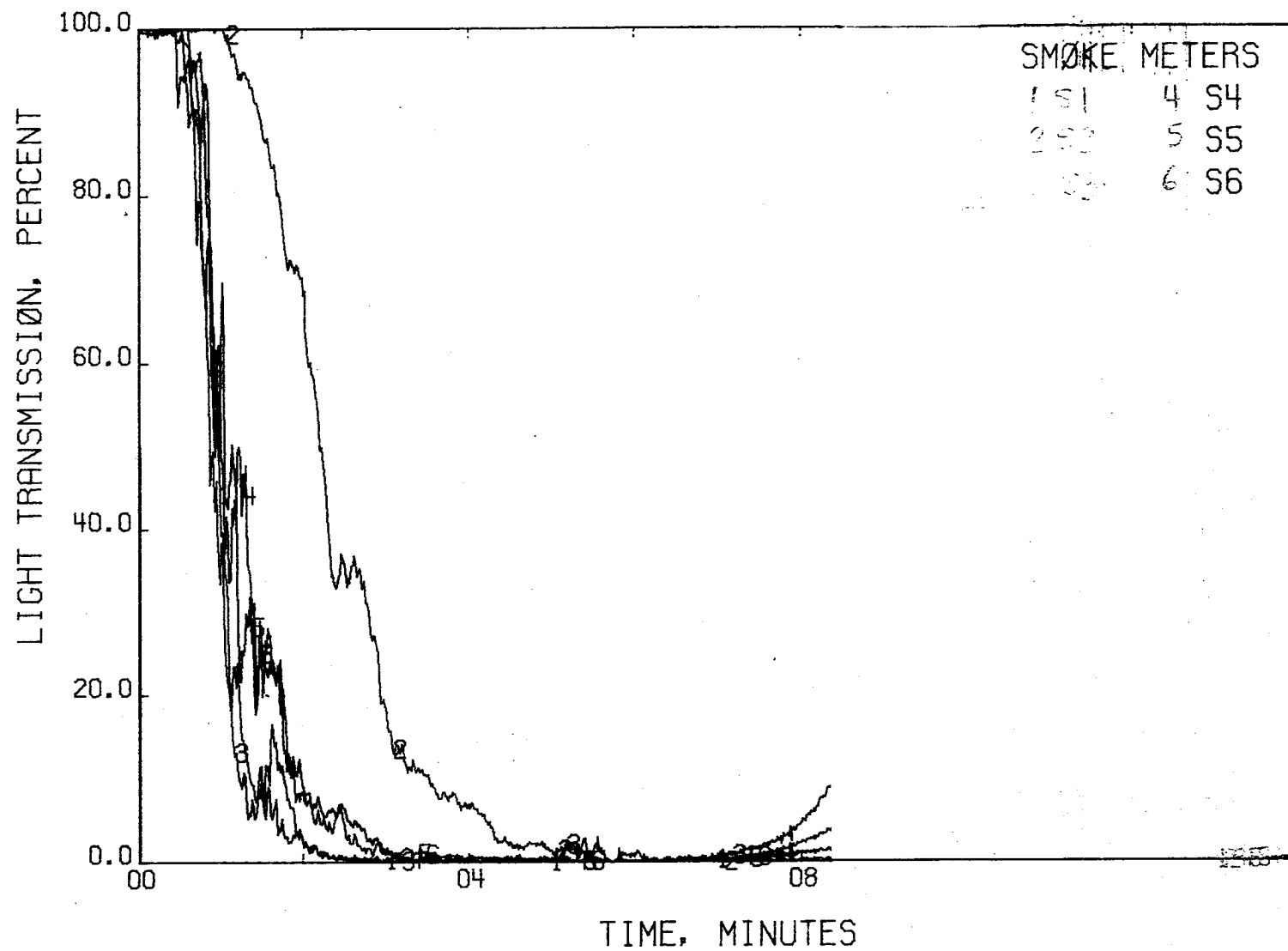


FIGURE 571 . - LIGHT TRANSMISSION  
TEST 24

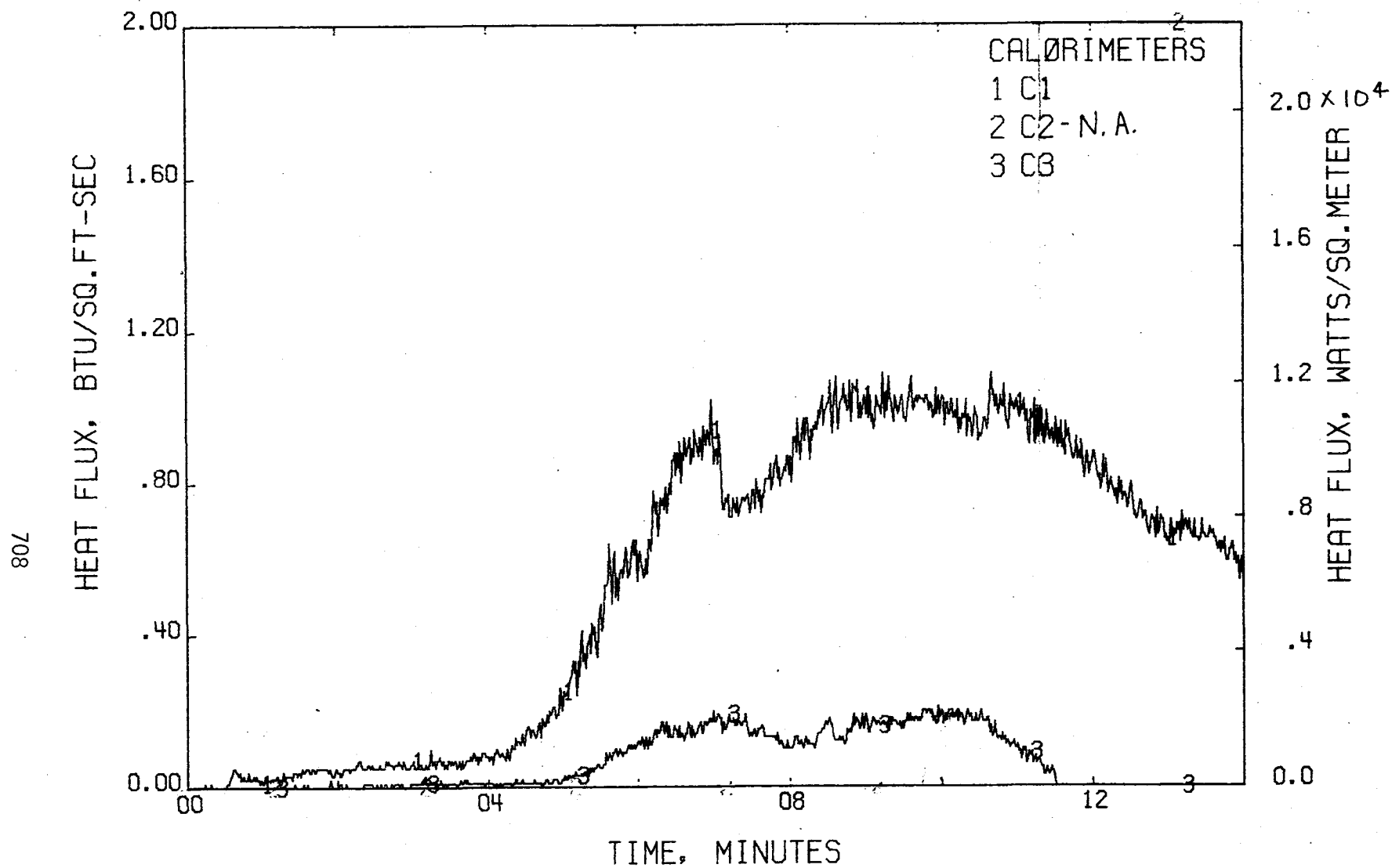


FIGURE 572 . - HEAT FLUX, AFT  
TEST 24.

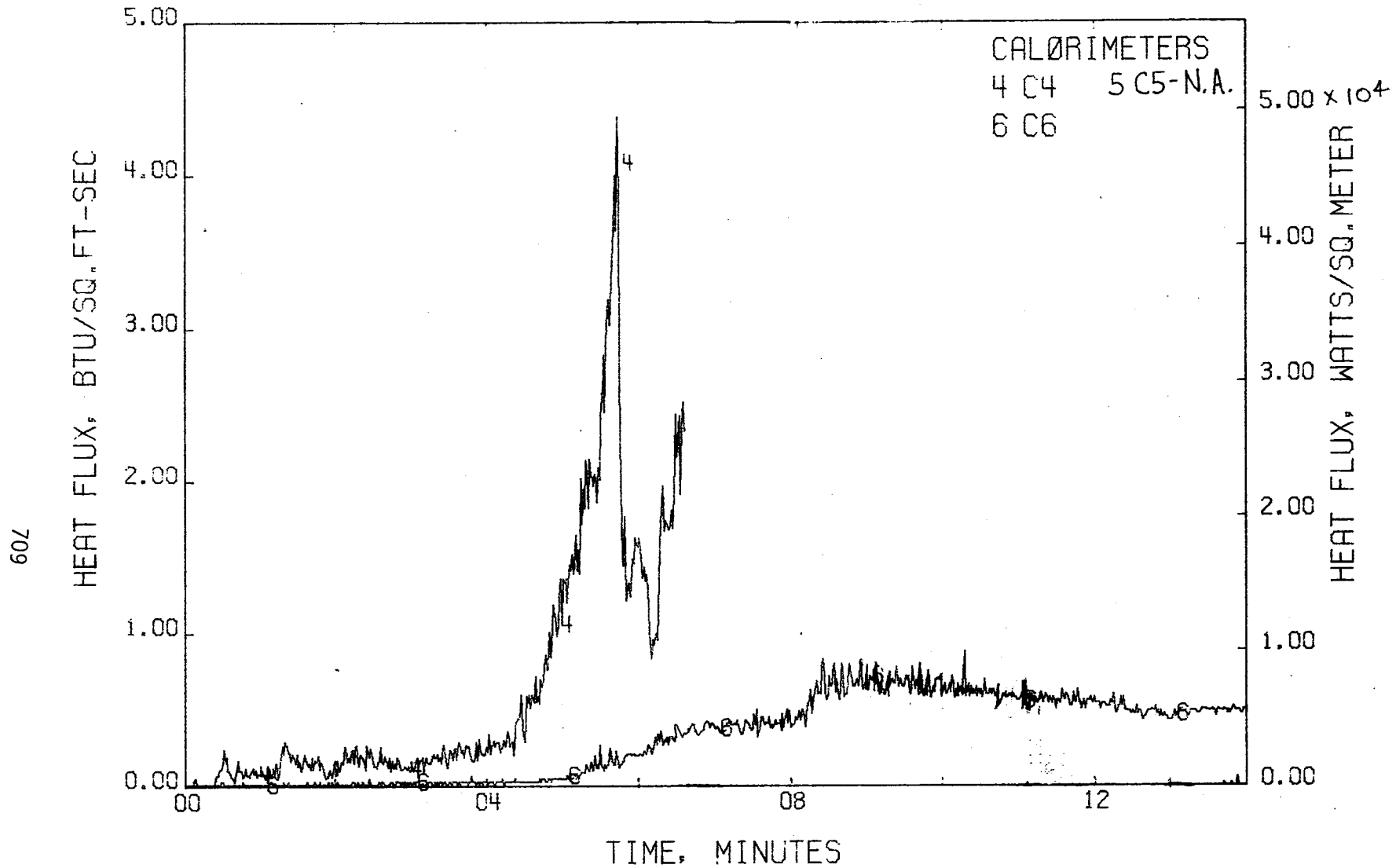


FIGURE 573 . - HEAT FLUX, MIDSECTION  
TEST 24

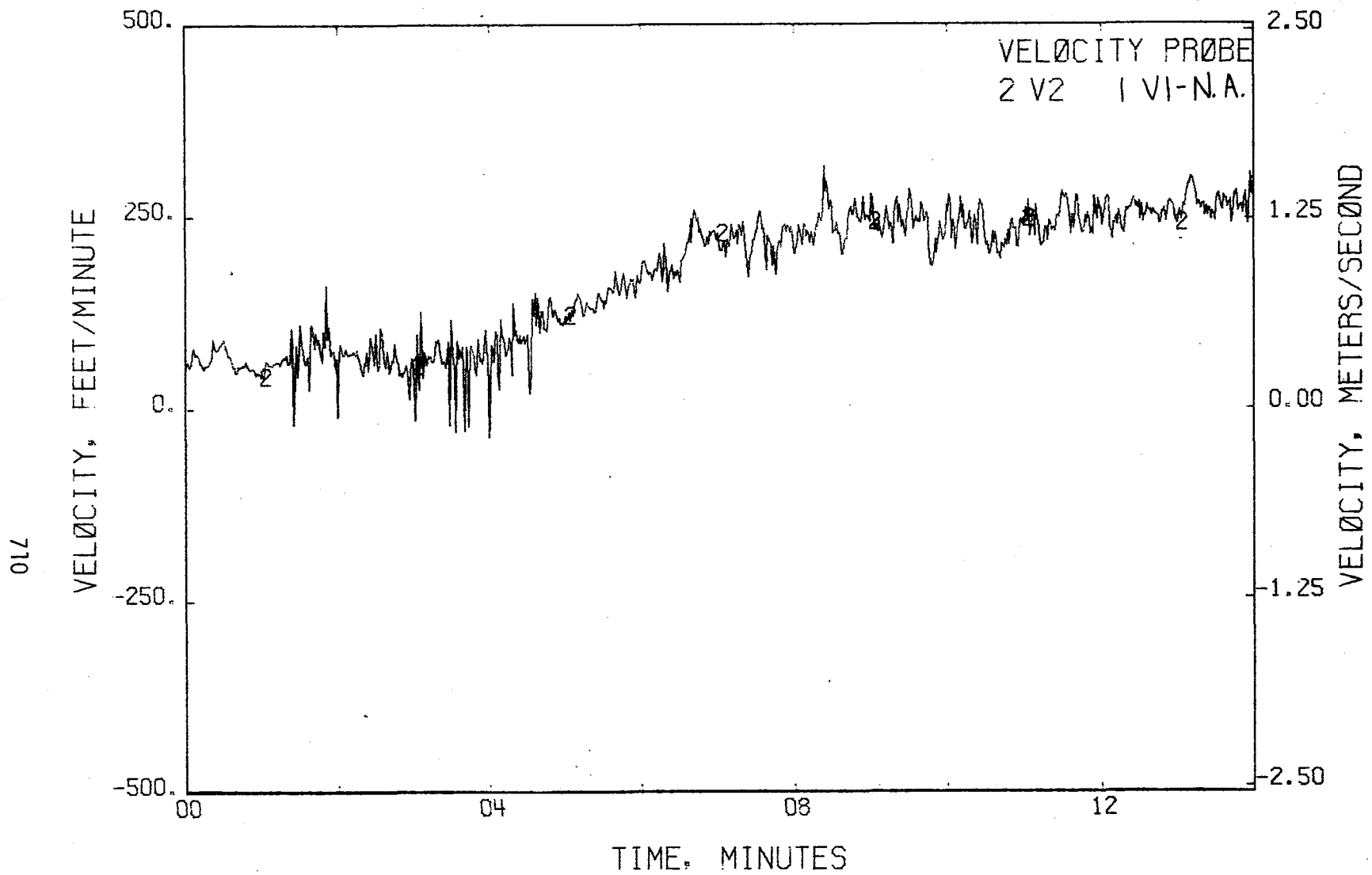


FIGURE 574 . - AIR VELOCITY  
TEST 24

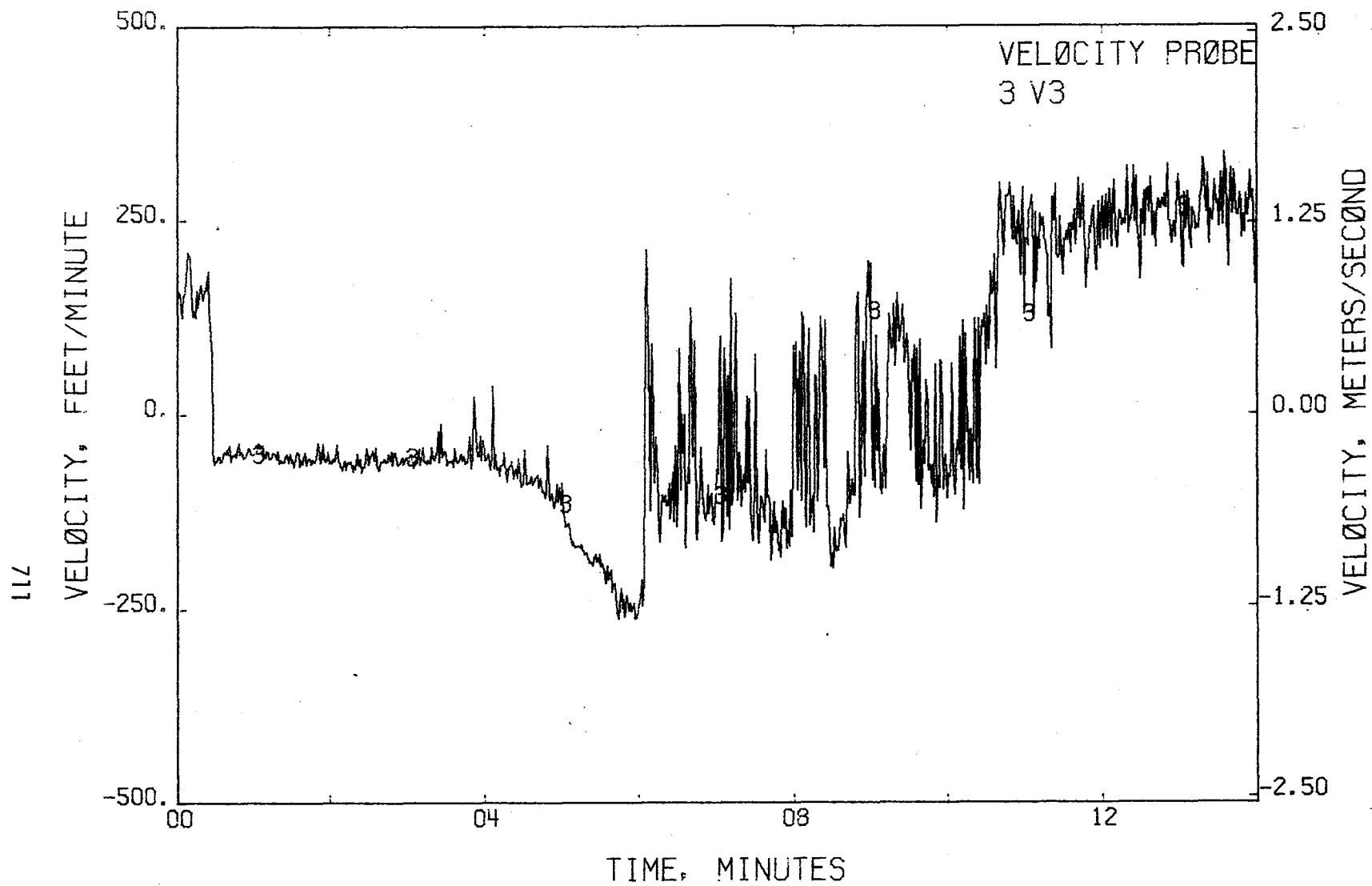


FIGURE 574 . - AIR VELOCITY-CONT.  
TEST 24

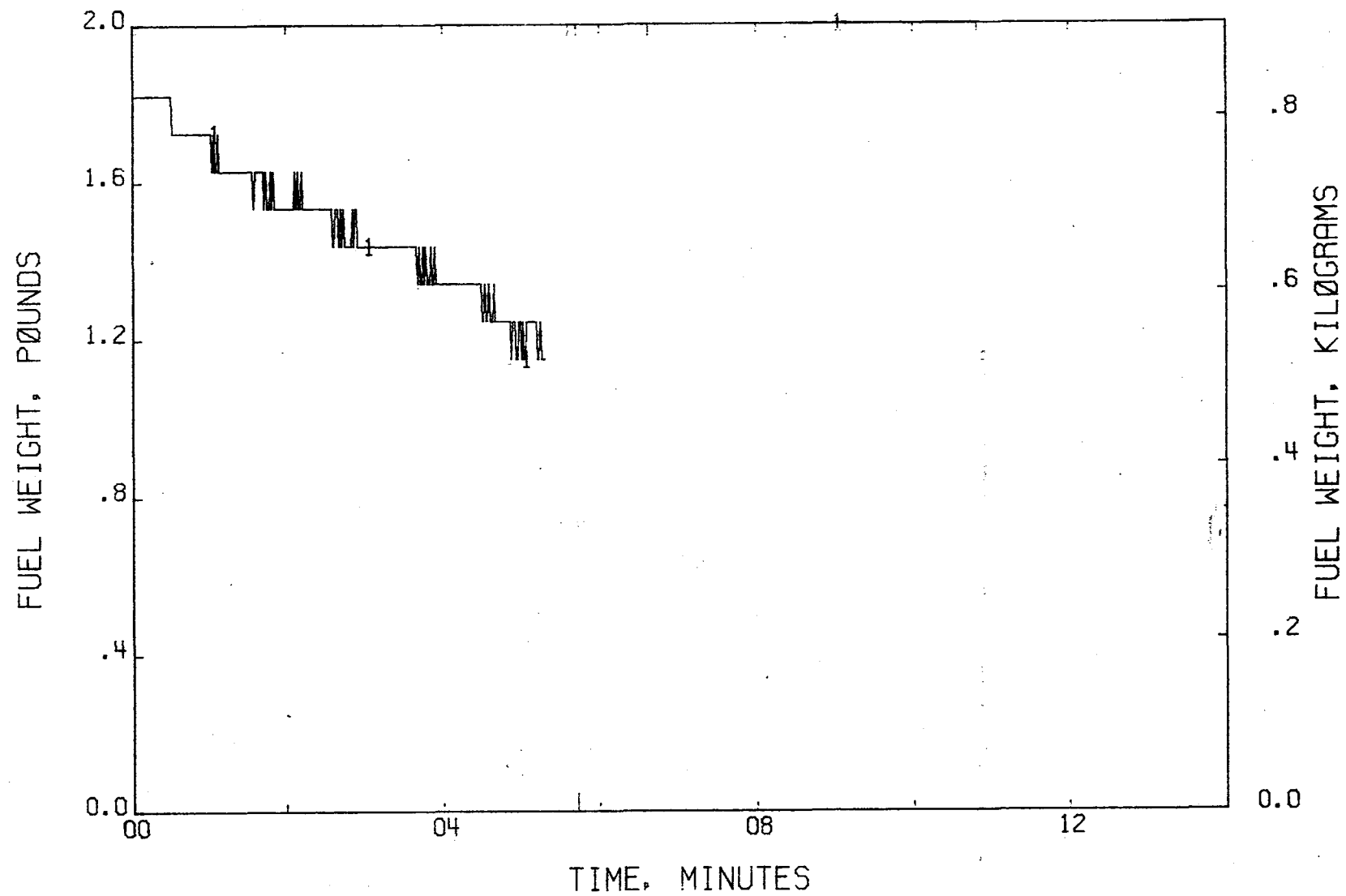


FIGURE 575 . - FUEL WEIGHT LOSS  
TEST 24



713

SEAT WEIGHT, POUNDS

250.0  
200.0  
150.0  
100.0  
50.0  
0.0

00

04

08

12

TIMES, MINUTES

DATA NOT AVAILABLE

100.

75.

50.

25.

0.

SEAT WEIGHT, KILOGRAMS

SEAT WEIGHT LOSS  
TEST 24

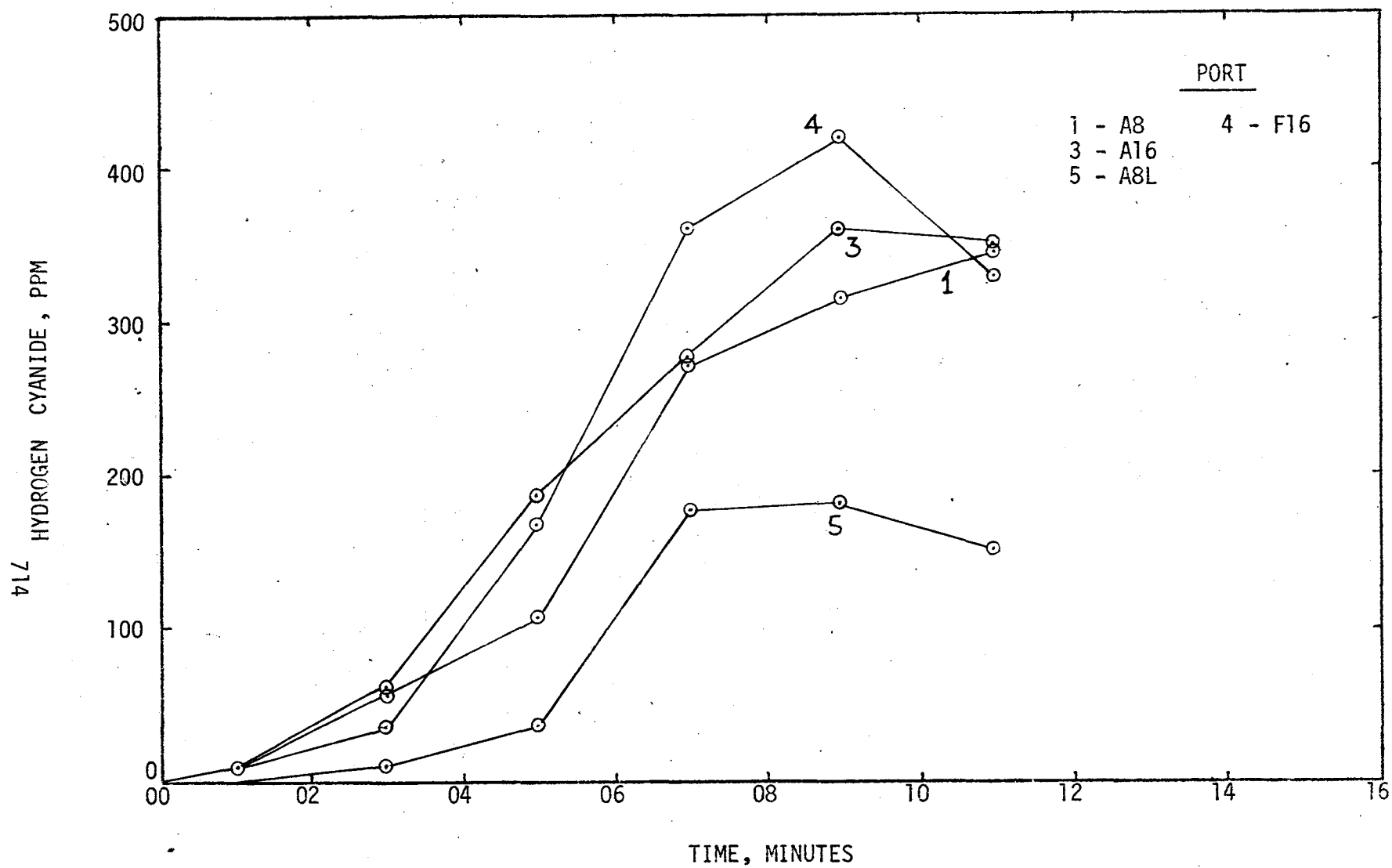


FIGURE 576 : - HYDROGEN CYANIDE CONCENTRATIONS

TEST 24

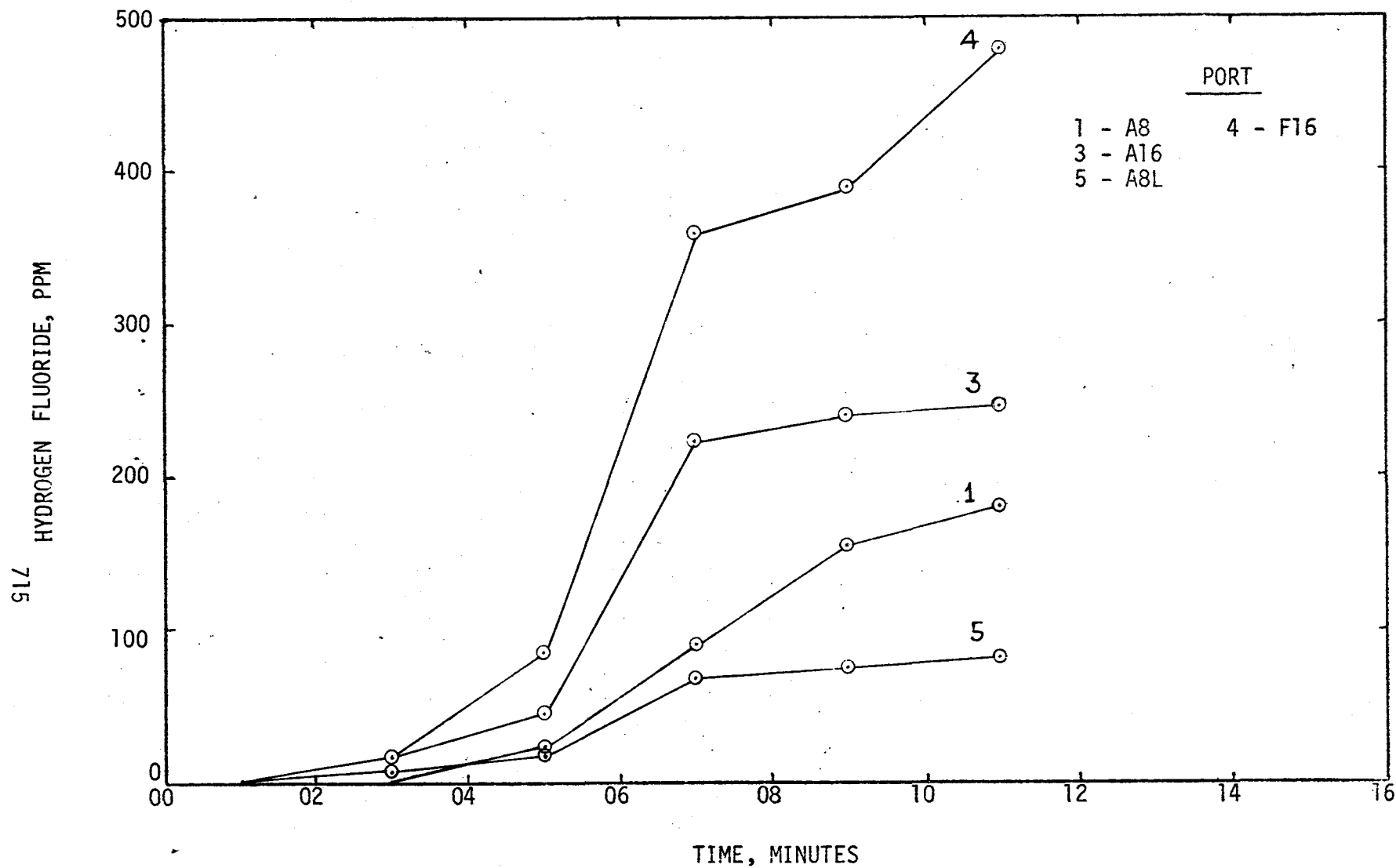


FIGURE 577 : - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 24

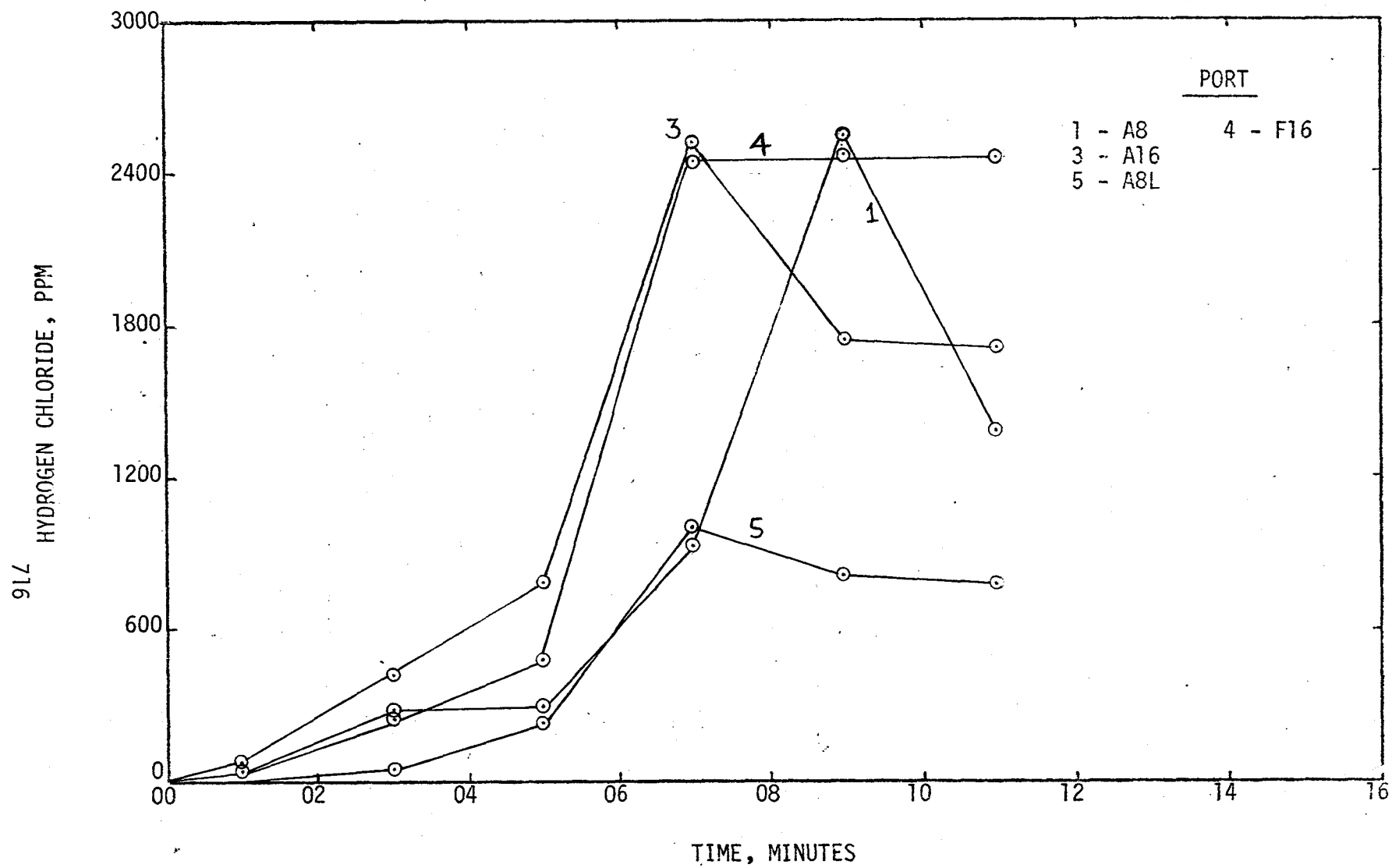


FIGURE 578 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 24

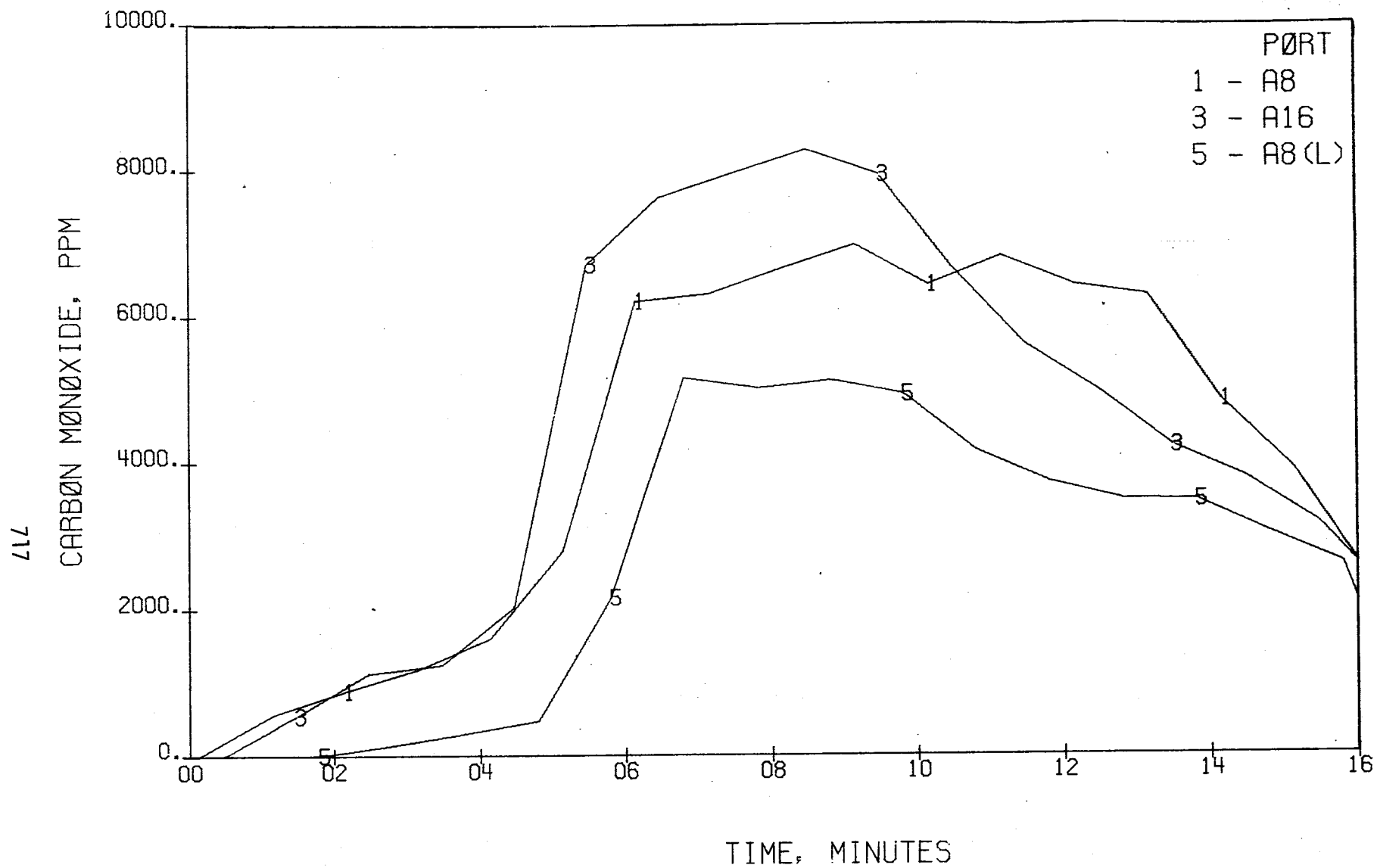


FIGURE 579 . - CARBON MONOXIDE CONCENTRATIONS , AFT  
TEST 24

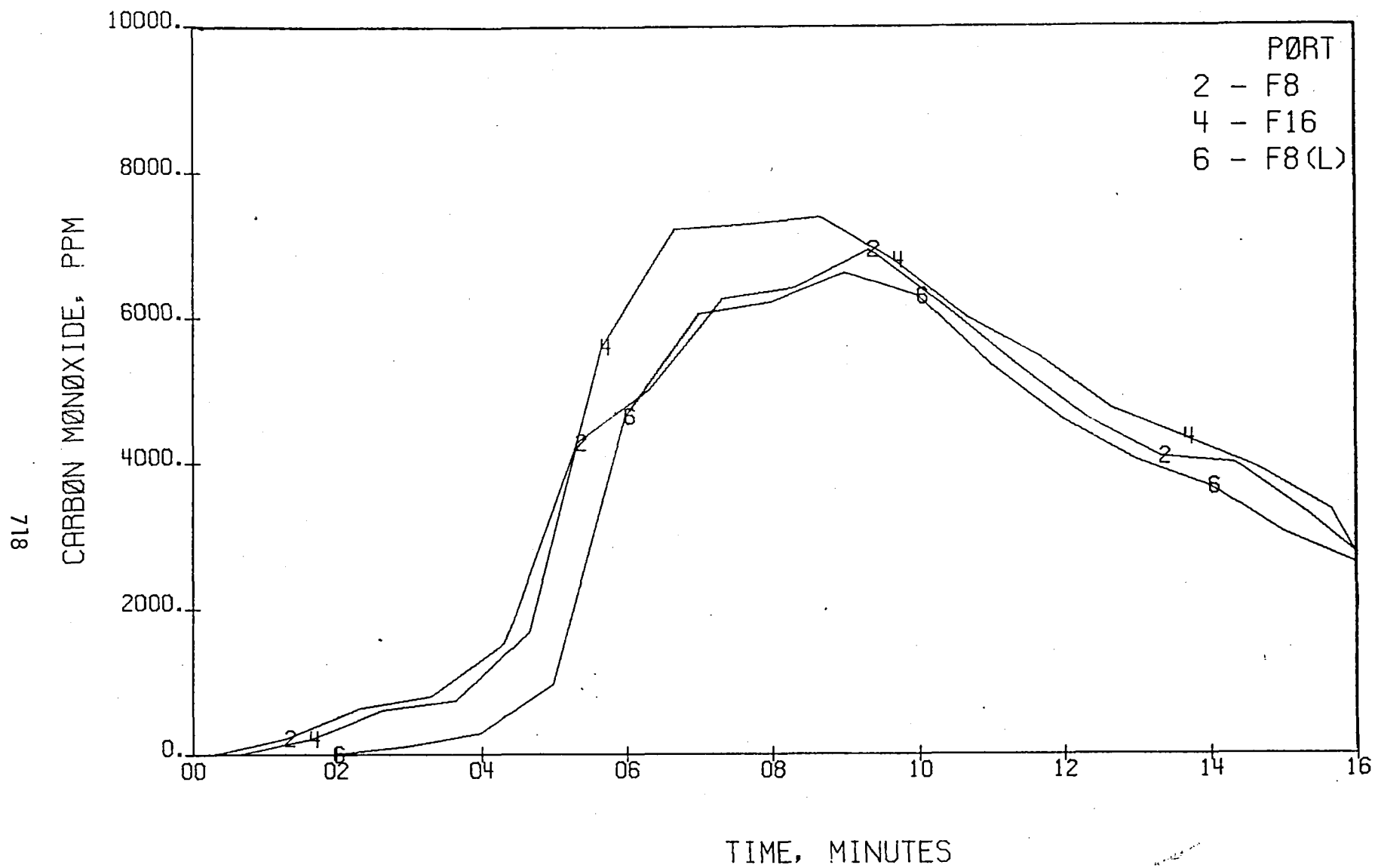


FIGURE 580 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 24

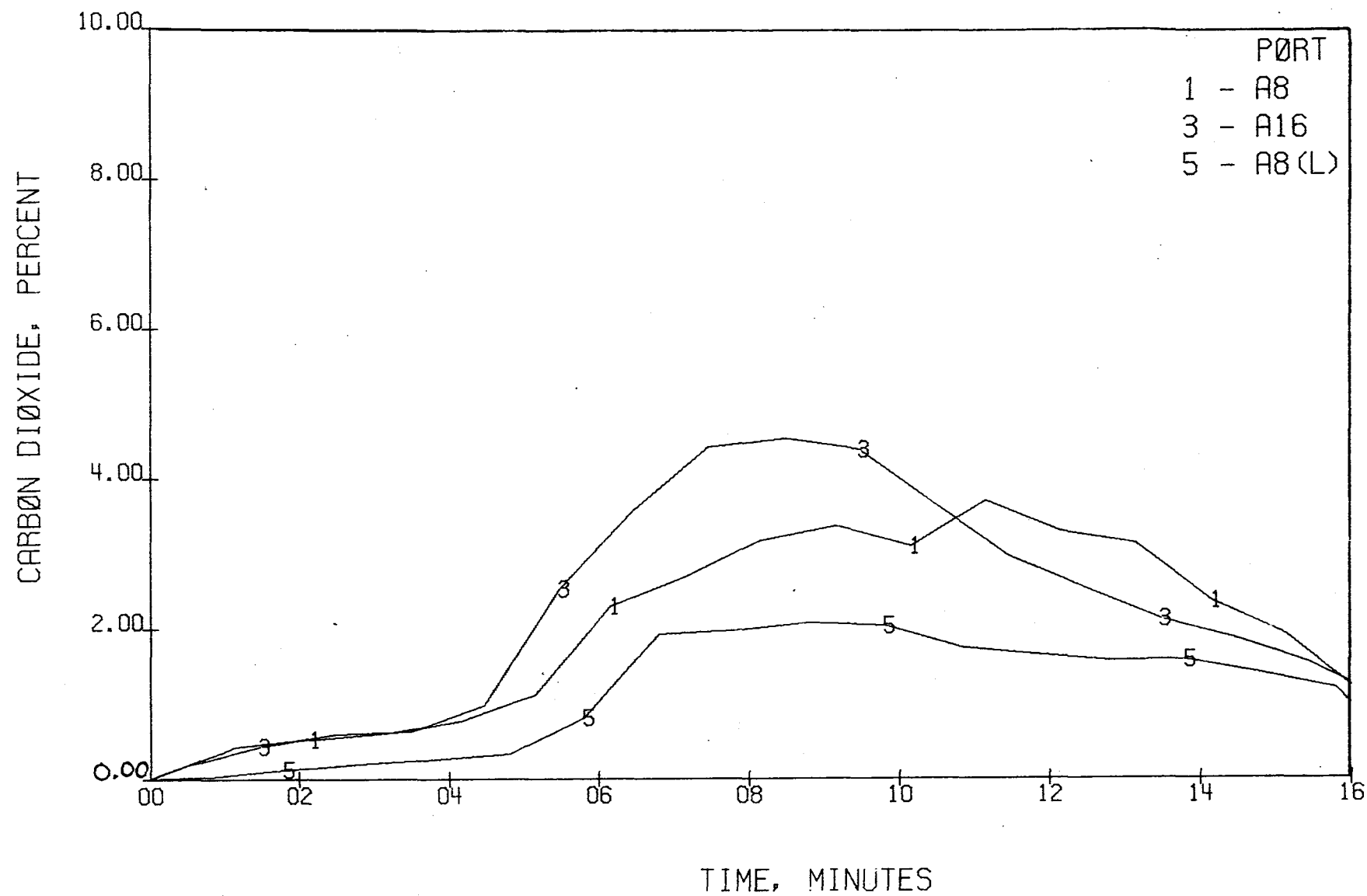


FIGURE 581 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 24

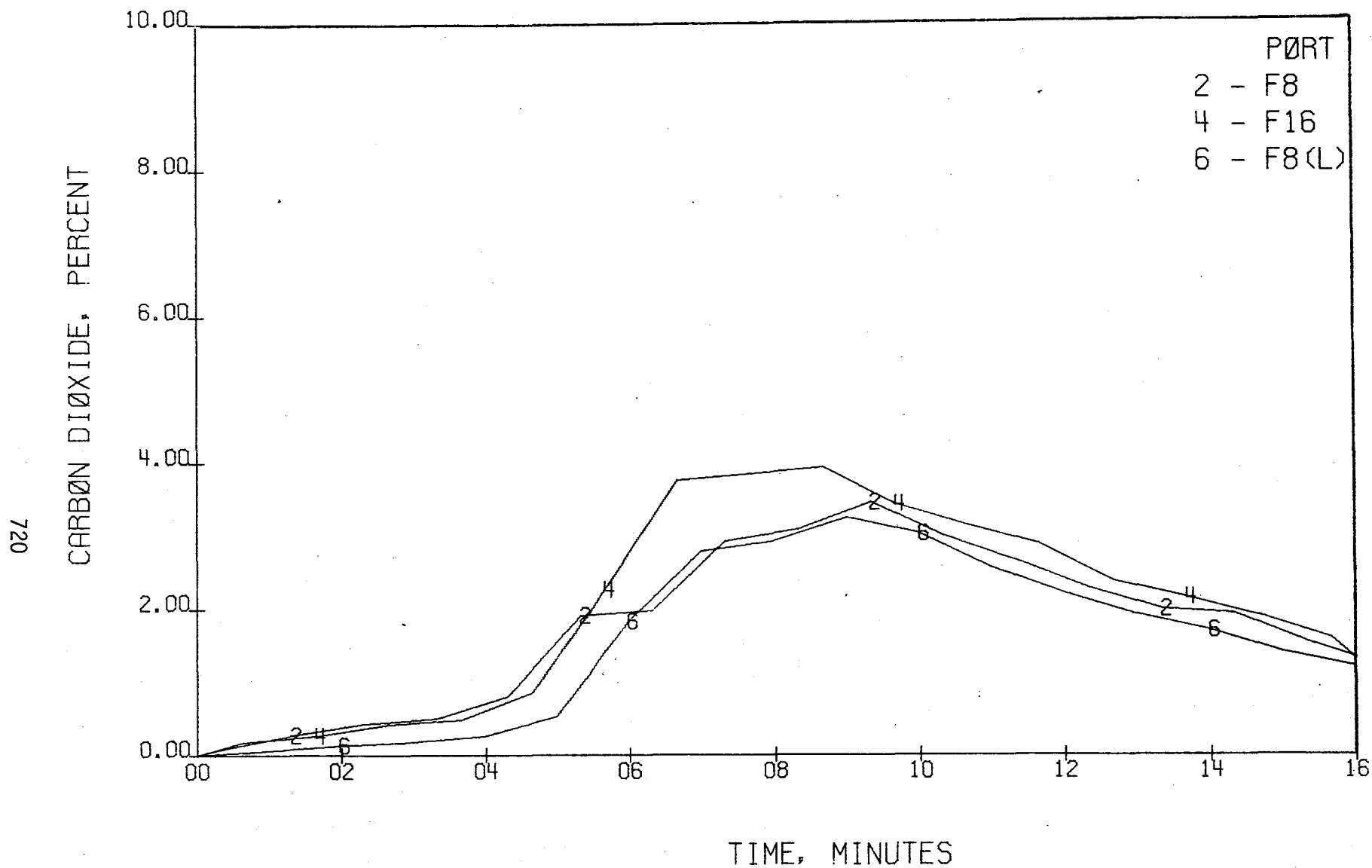


FIGURE 582 . - CARBON DIOXIDE CONCENTRATIONS , FØRE  
TEST 24



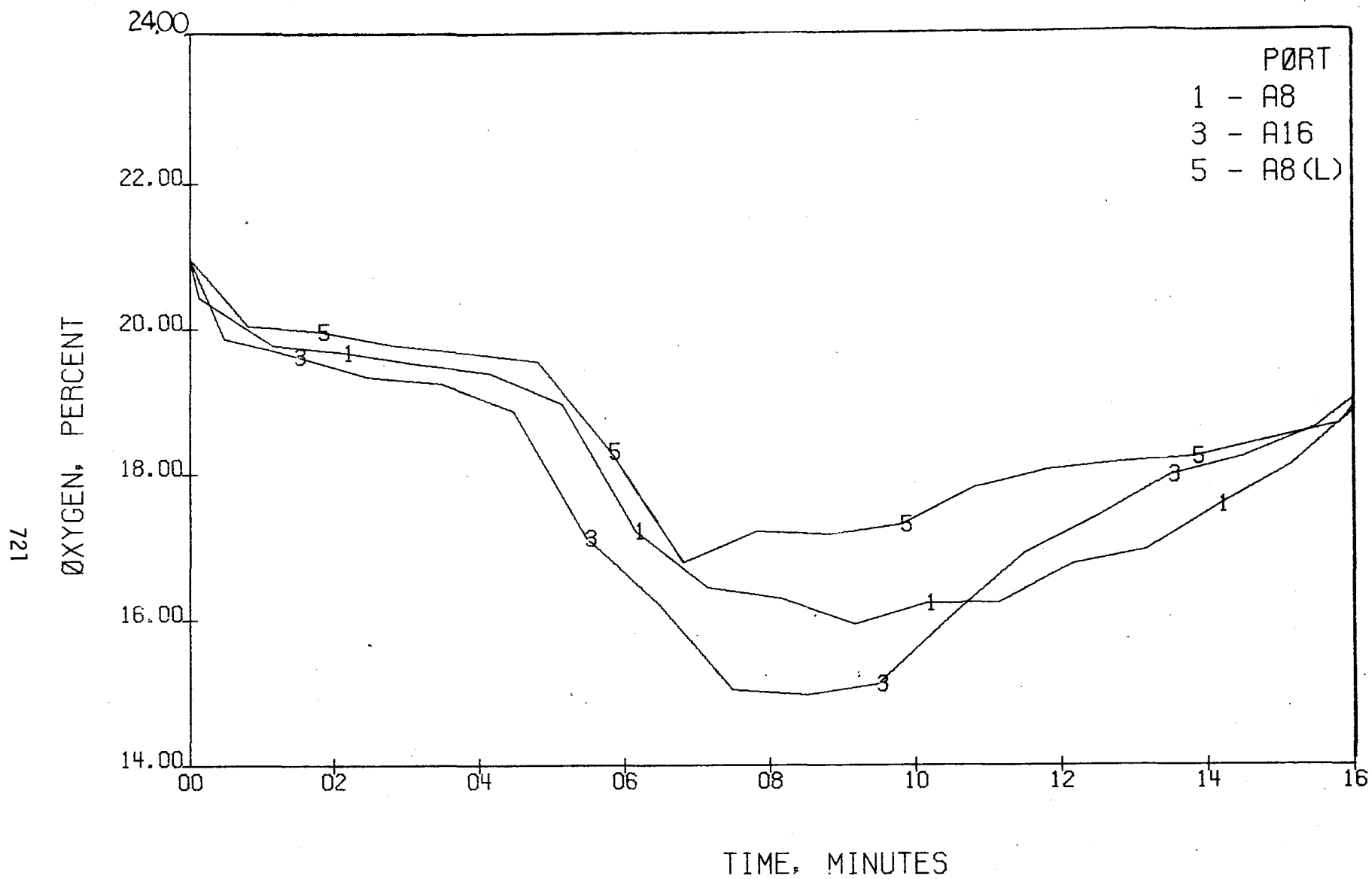


FIGURE 583 . - OXYGEN CONCENTRATIONS , AFT  
TEST 24

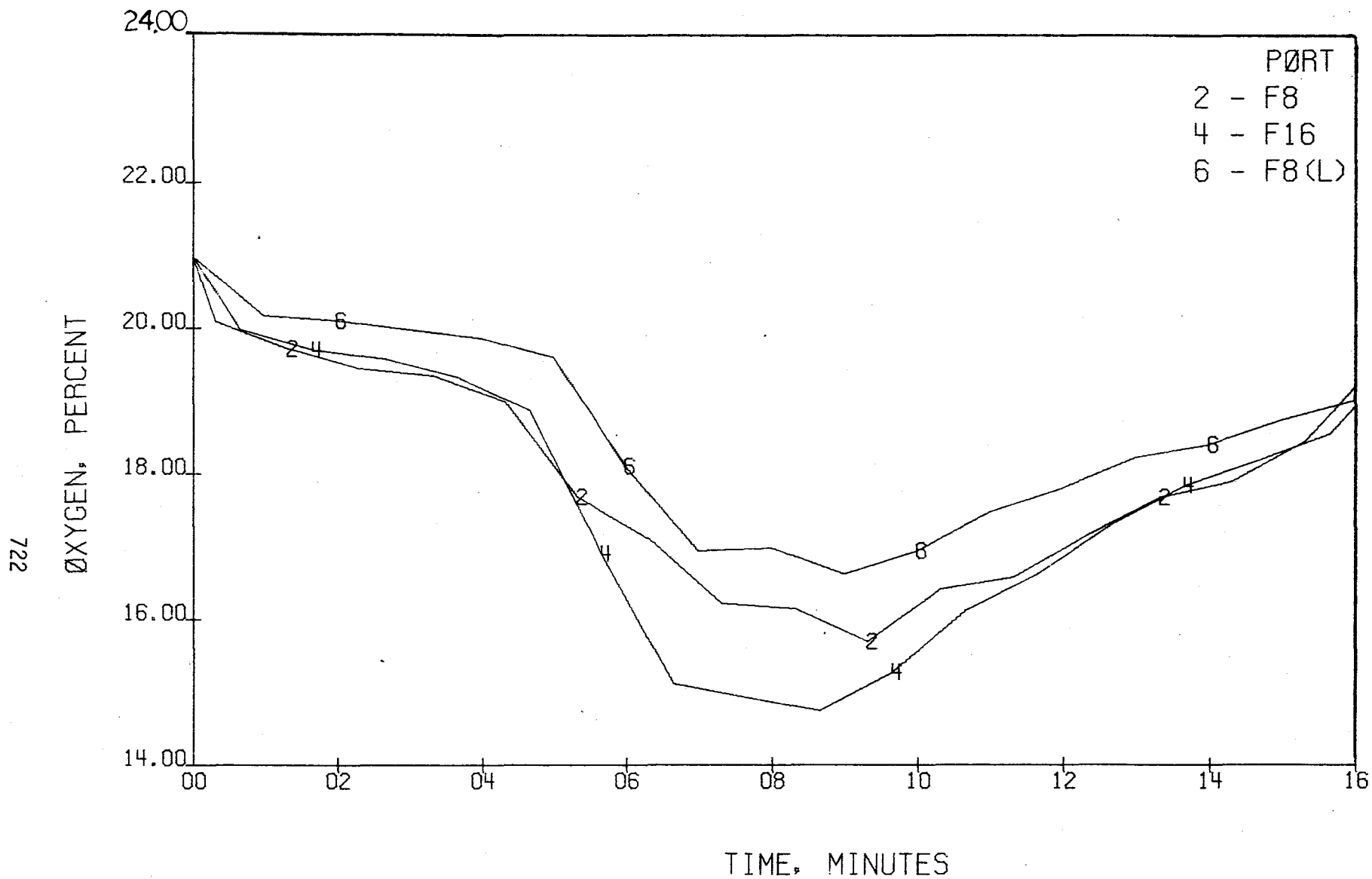


FIGURE 584 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 24

723

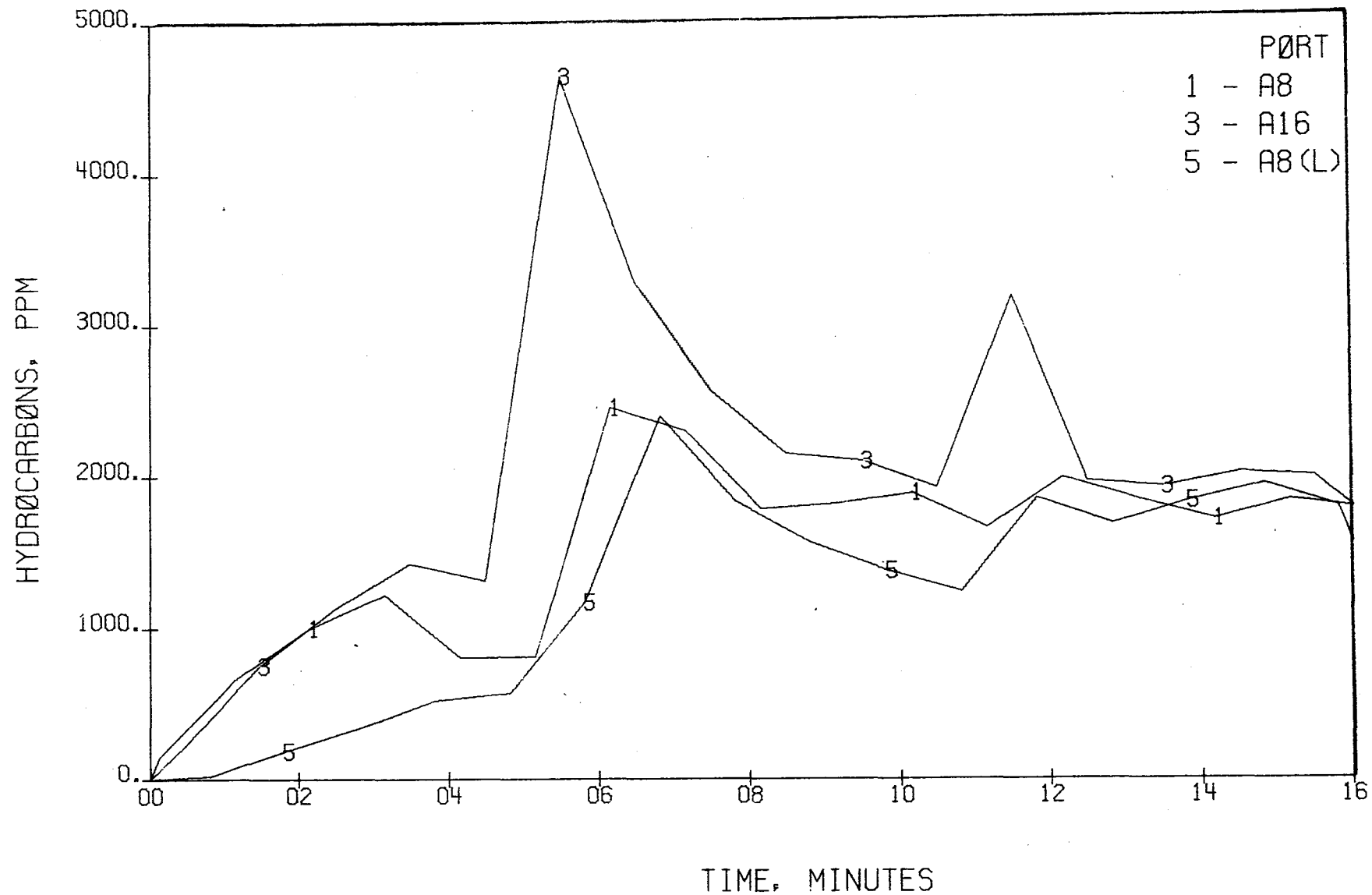


FIGURE 585 . - HYDROCARBONS CONCENTRATIONS , AFT  
TEST 24

724

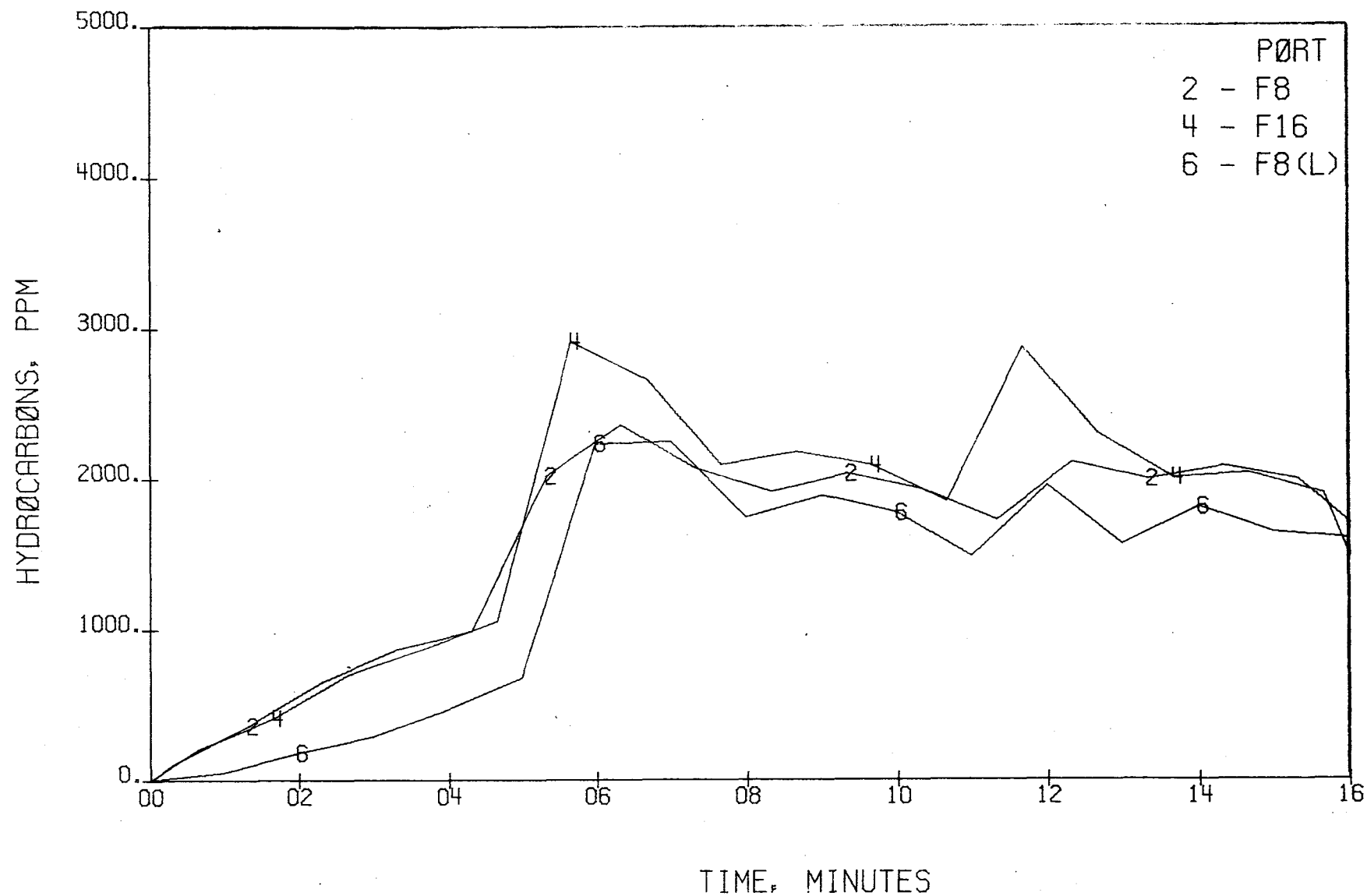


FIGURE 586 . - HYDROCARBONS CONCENTRATIONS, FØRE  
TEST 24

TEST 25

---

COVERED URETHANE FOAM SEATS

COVERED URETHANE FOAM SEATS

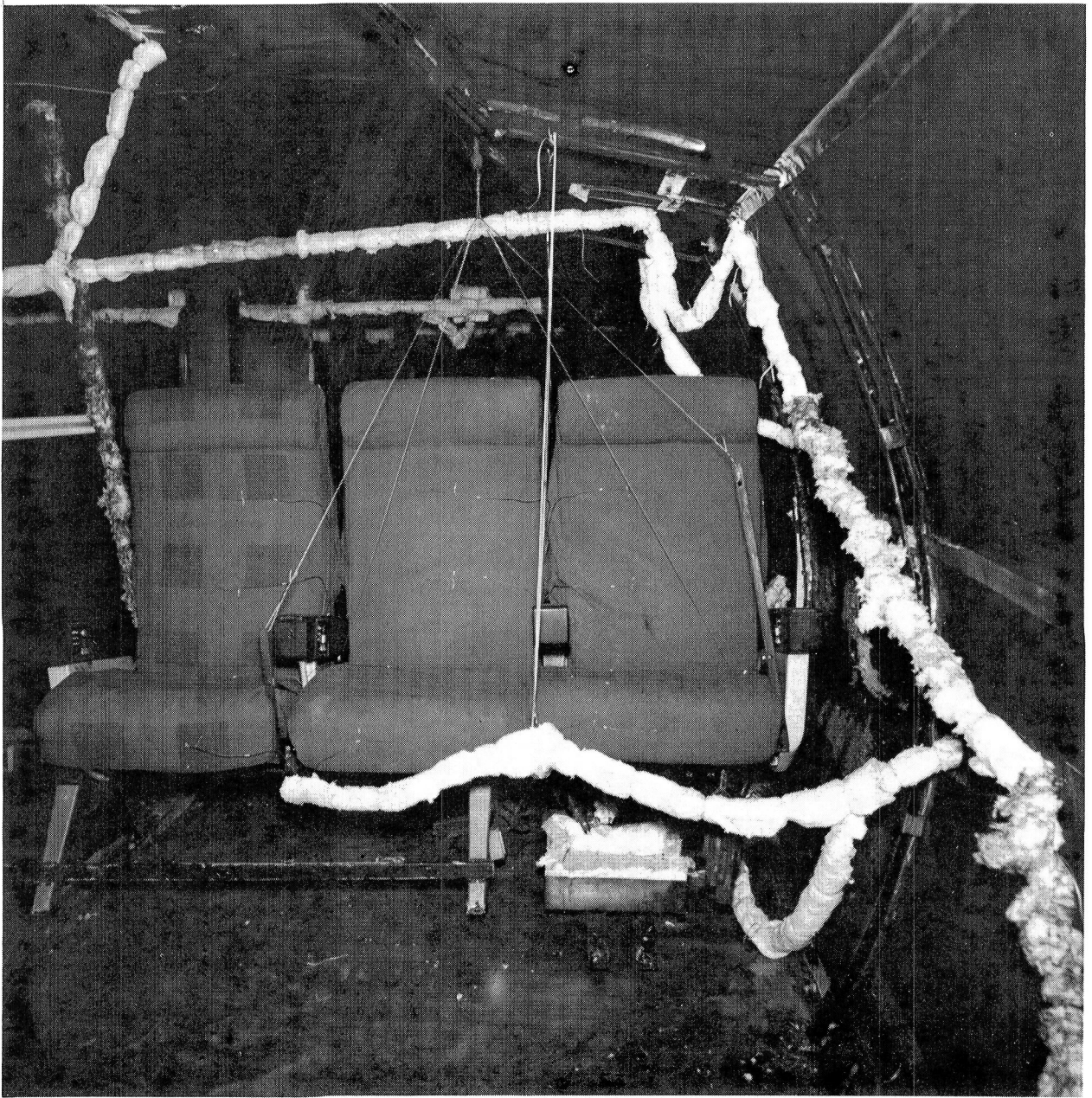


FIGURE 587 . - PRE-TEST CONFIGURATION, TEST 25



FIGURE 588 . - POST-TEST CONFIGURATION, TEST 25





FIGURE 589 . - FIRE DURING TEST 25



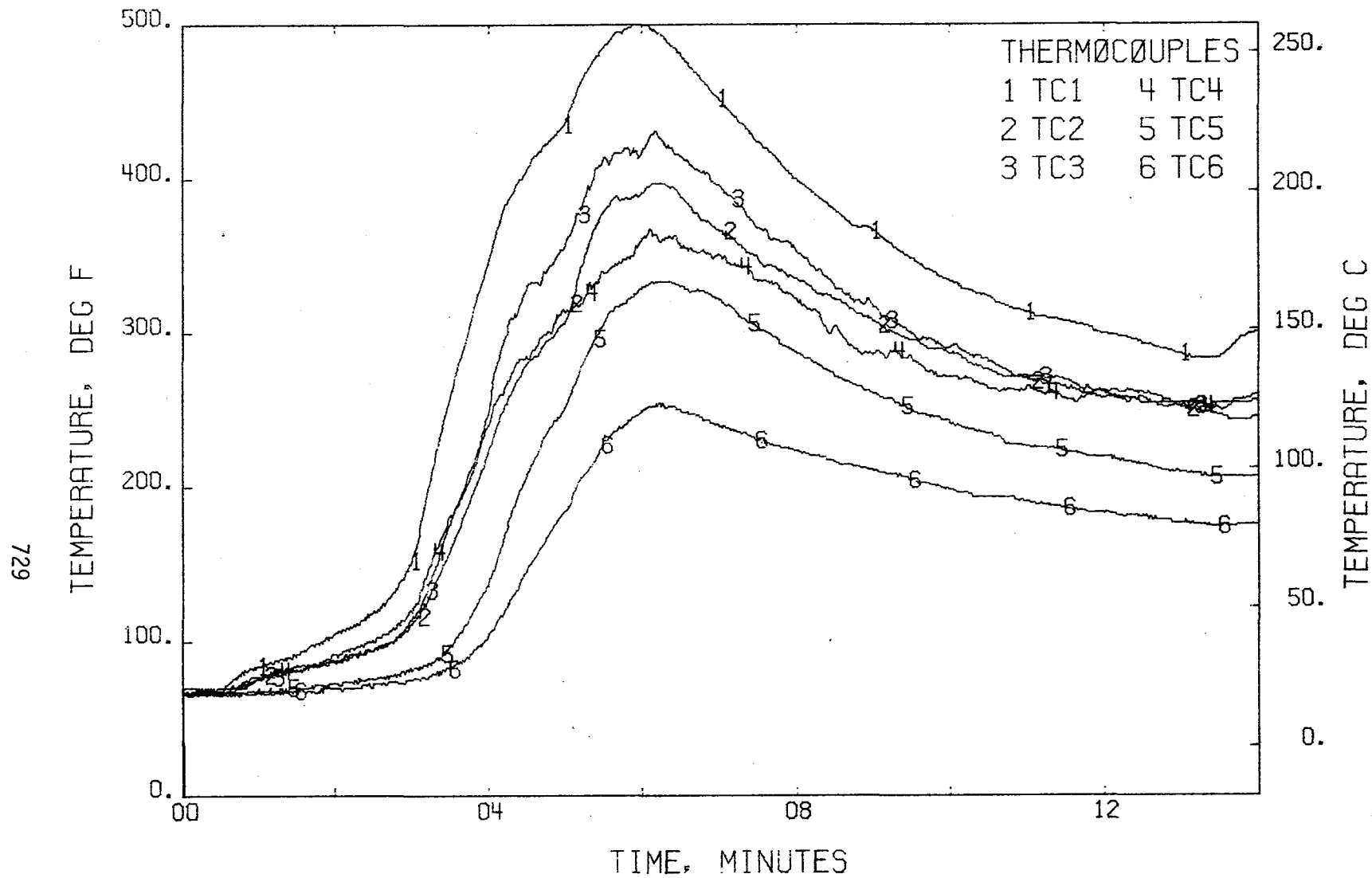


FIGURE 590 . - TEMPERATURES, T/C TREE 1  
TEST 25

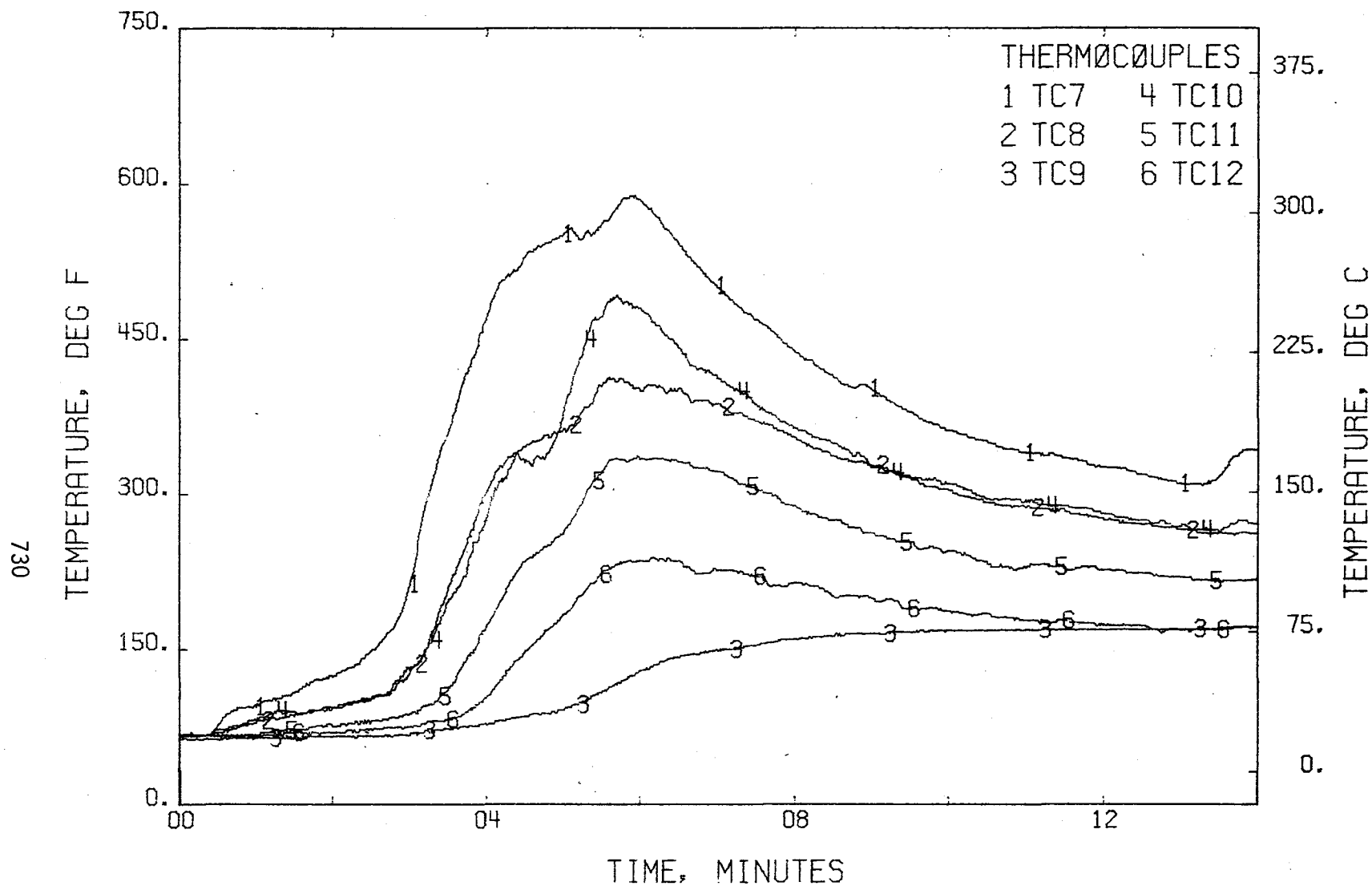


FIGURE 591 . - TEMPERATURES, T/C TREE 2  
TEST 25

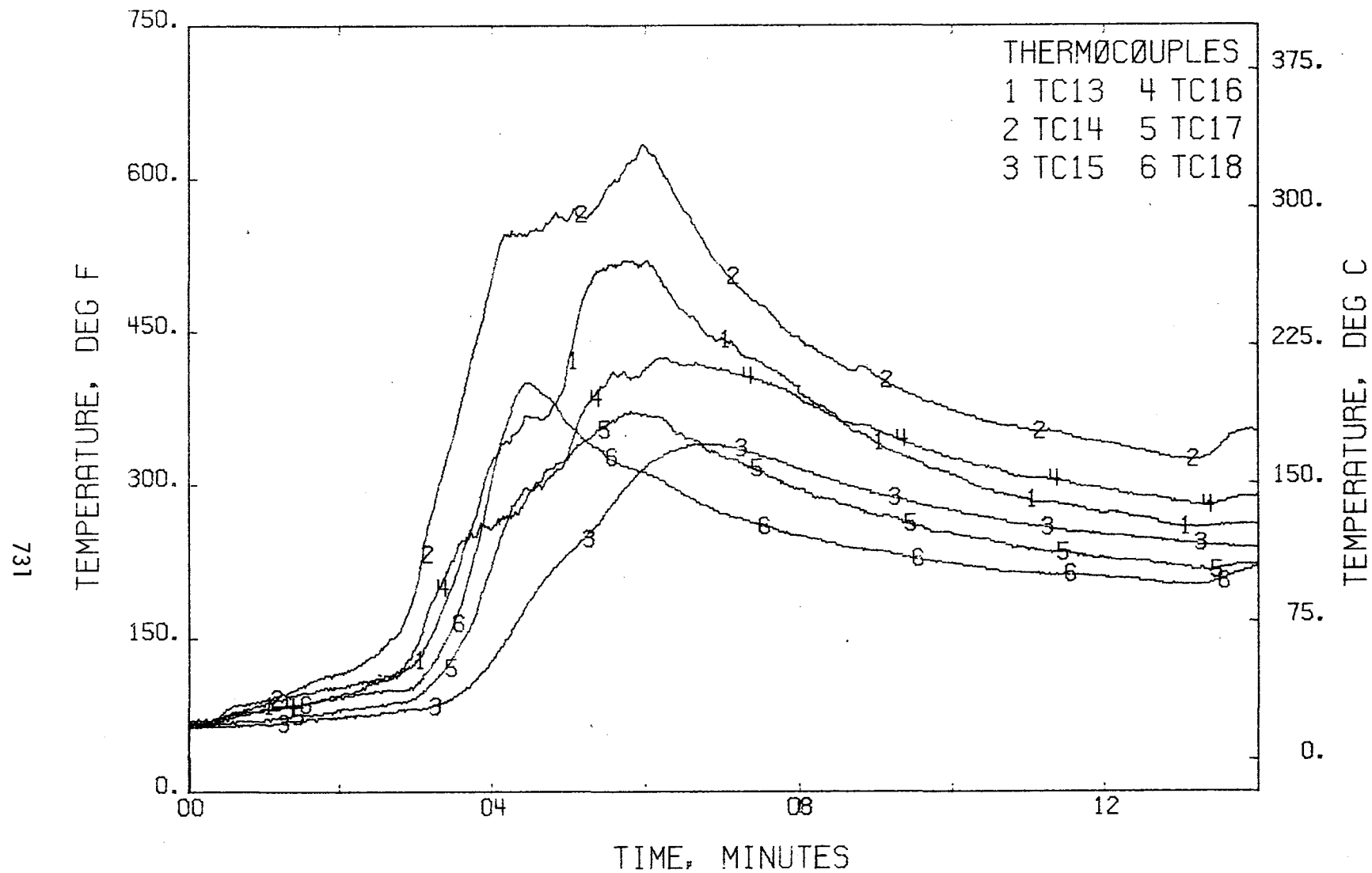


FIGURE 592 . - TEMPERATURES, T/C TREE 3  
TEST 25

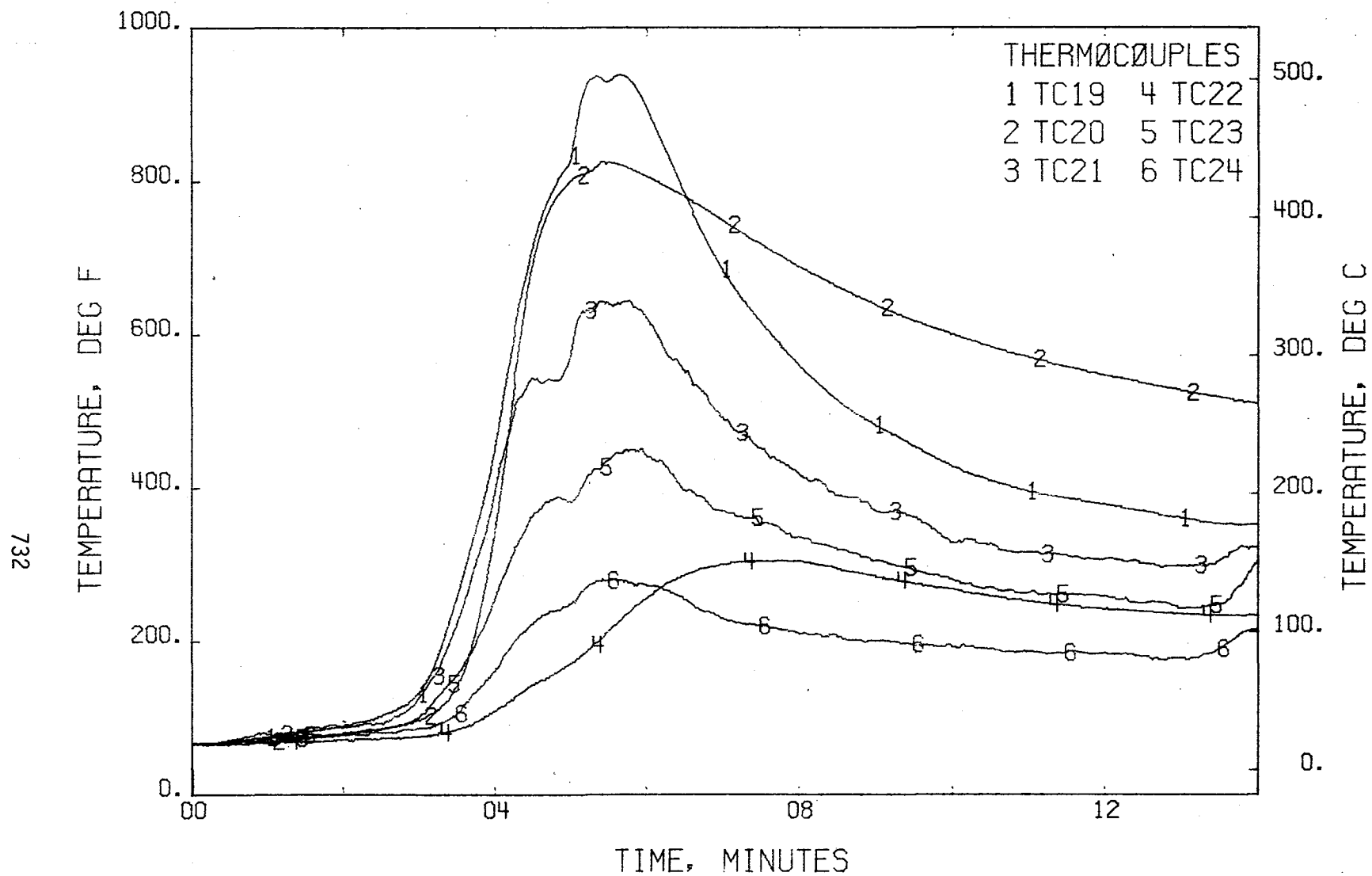


FIGURE 593 . - TEMPERATURES, T/C TREE 4  
TEST 25

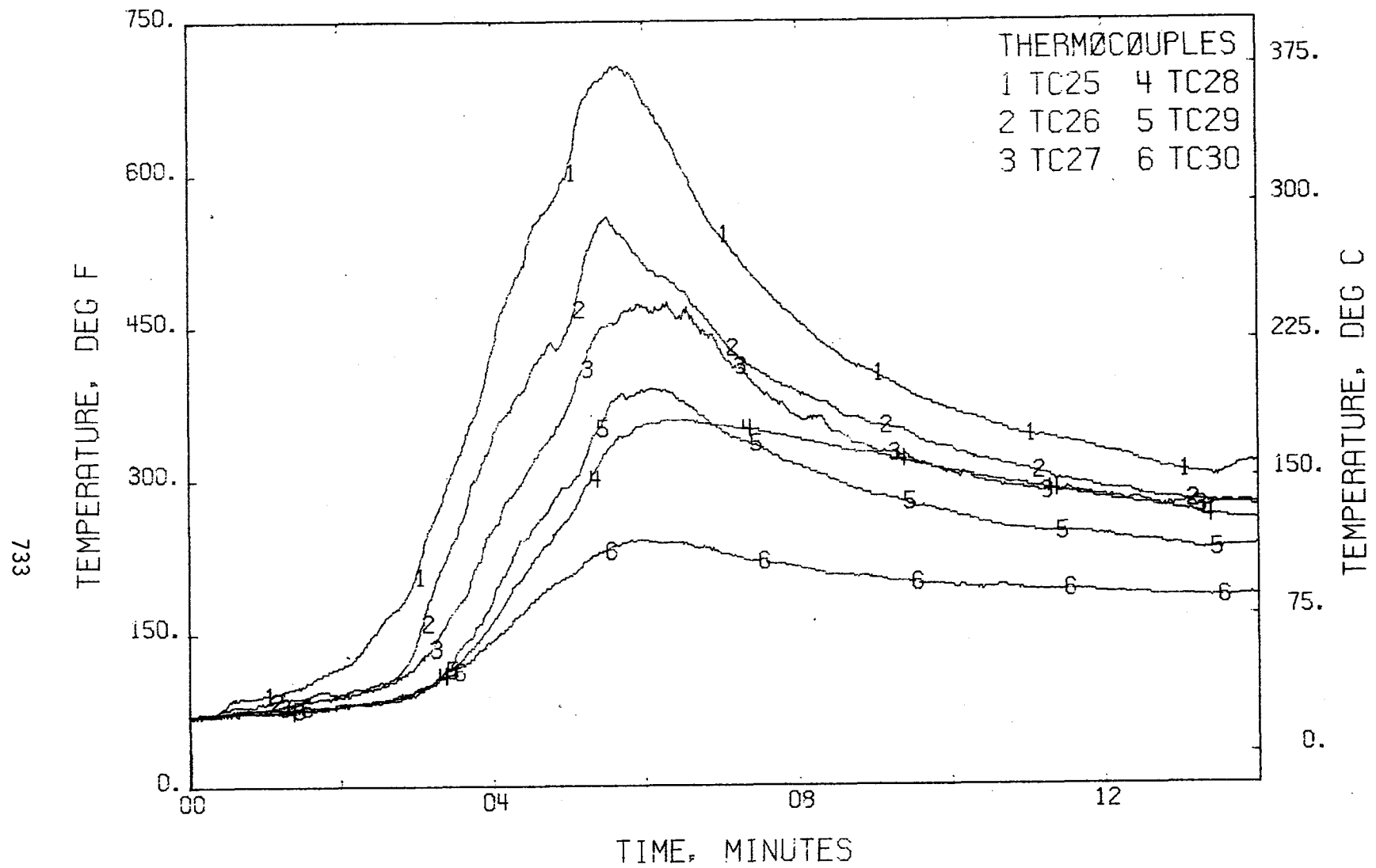


FIGURE 594 . - TEMPERATURES, T/C TREE 5  
TEST 25

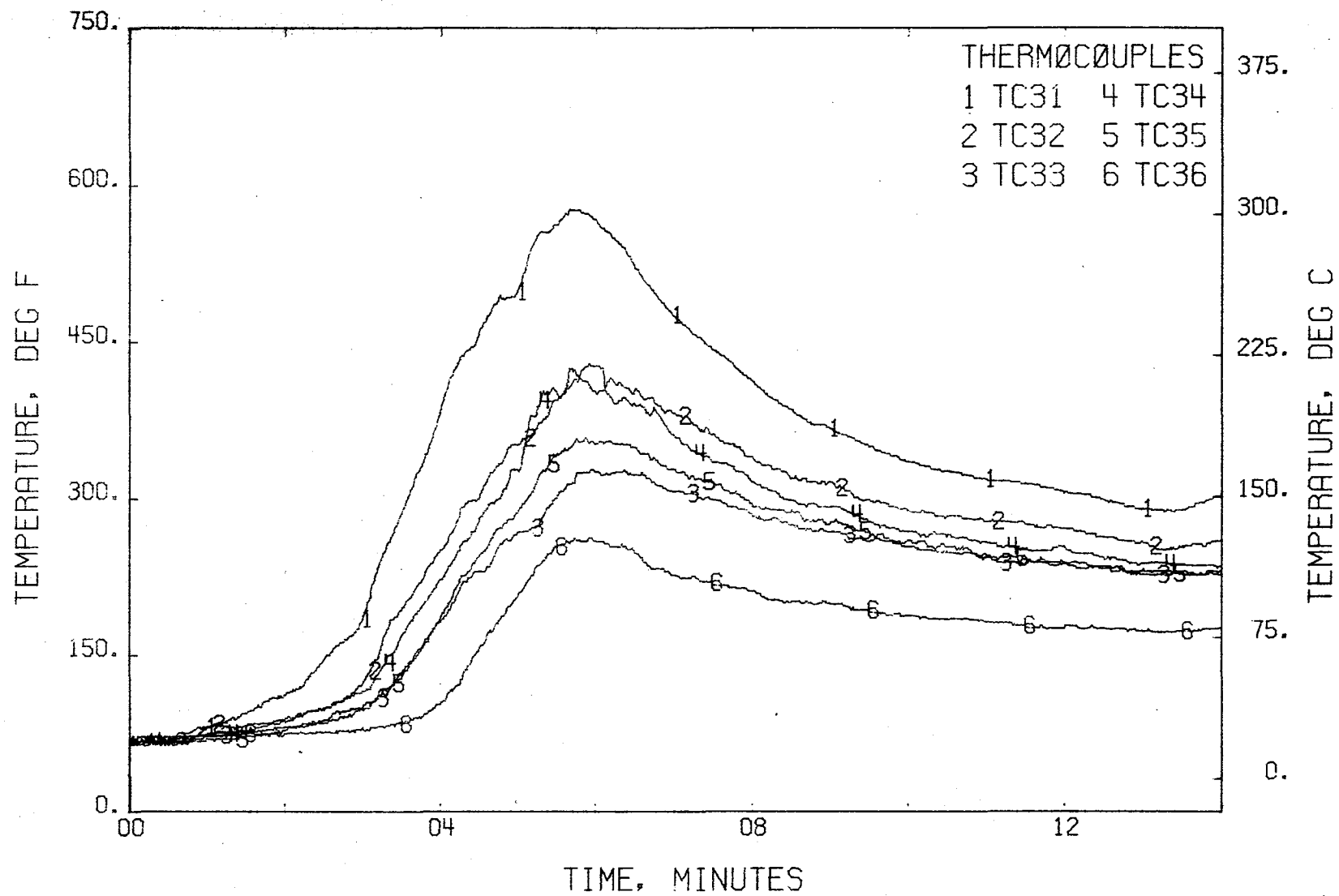


FIGURE 595 . - TEMPERATURES, T/C TREE 6  
TEST 25

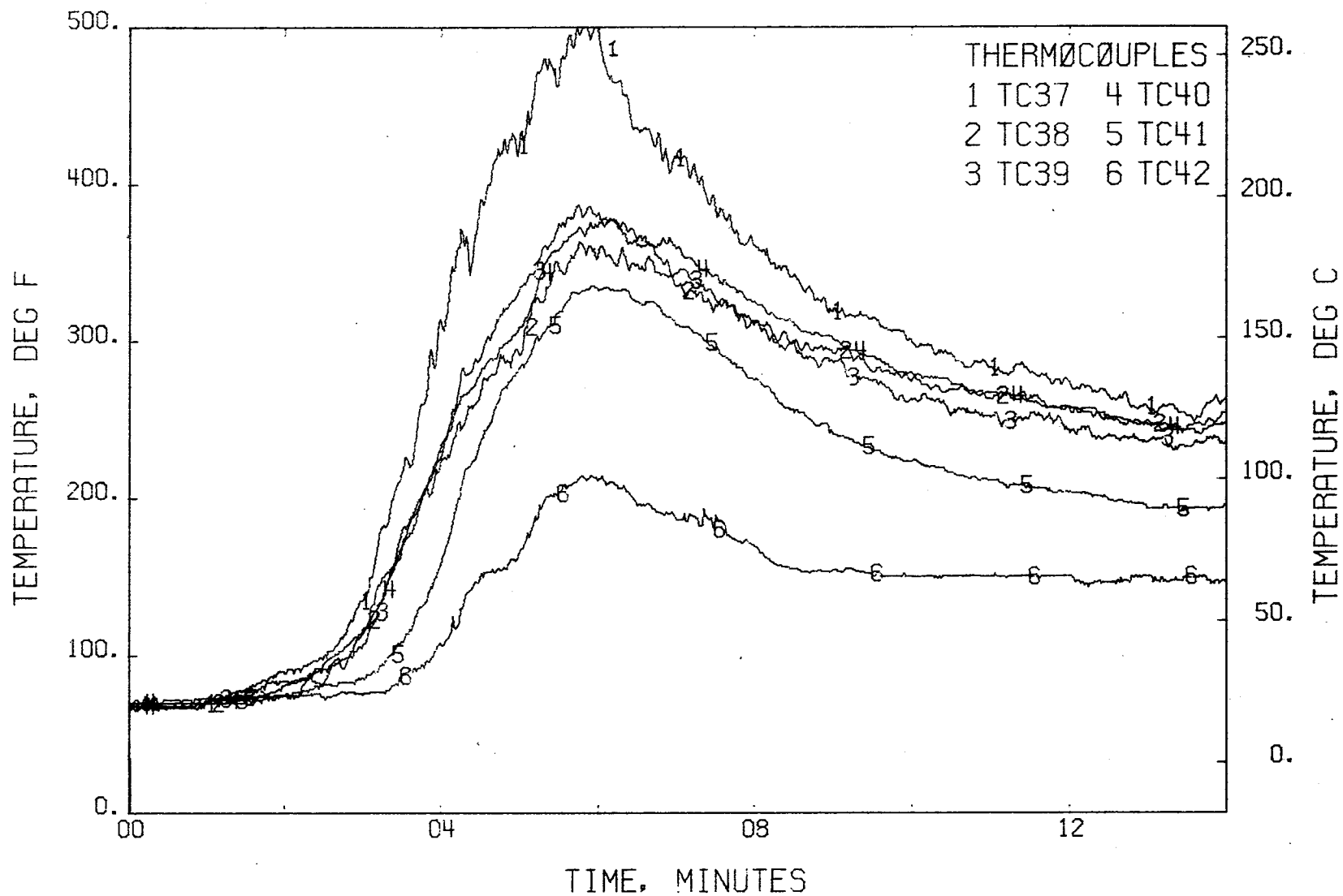


FIGURE 596 . - TEMPERATURES, T/C TREE 7  
TEST 25

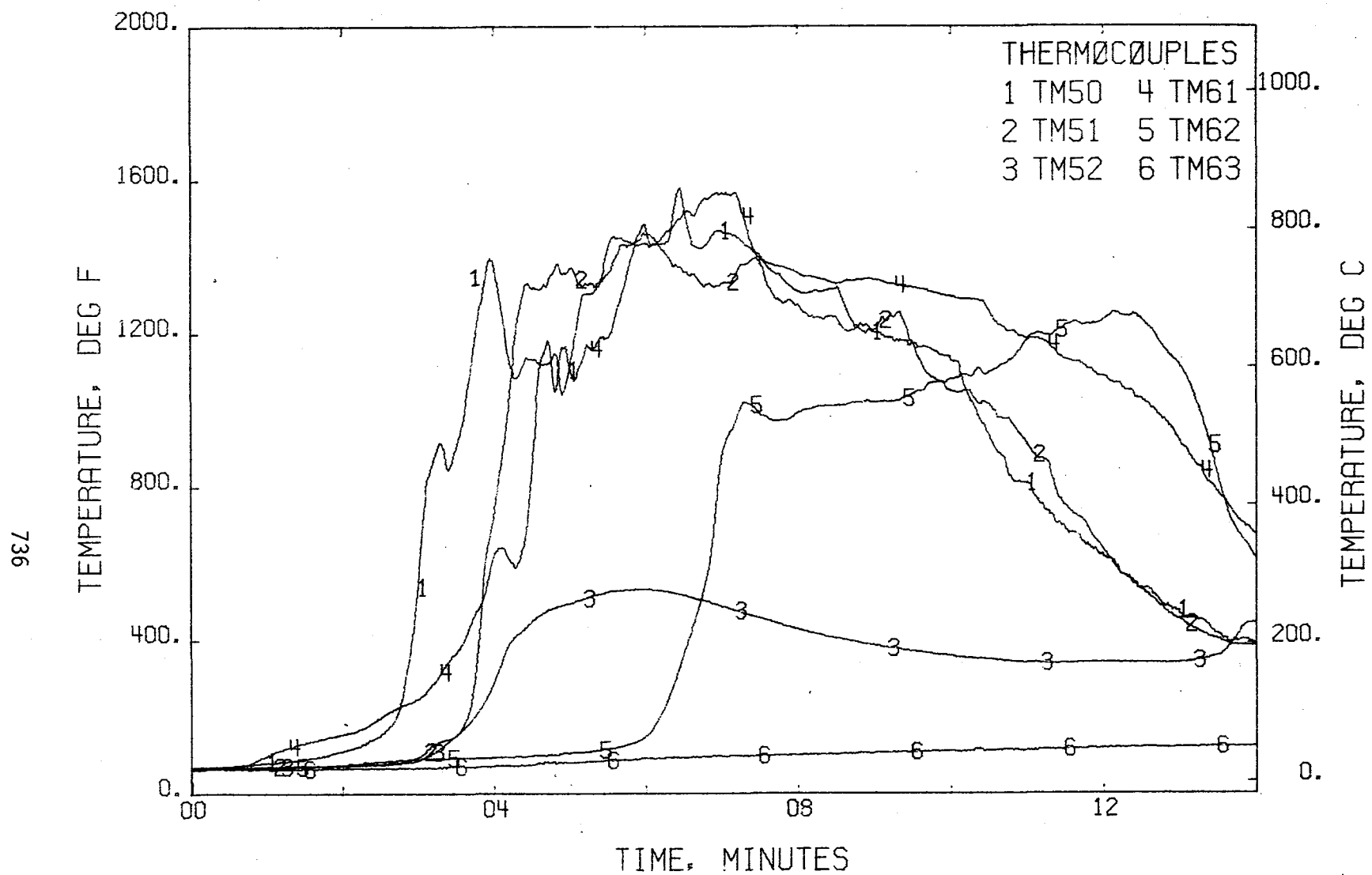


FIGURE 597 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 25



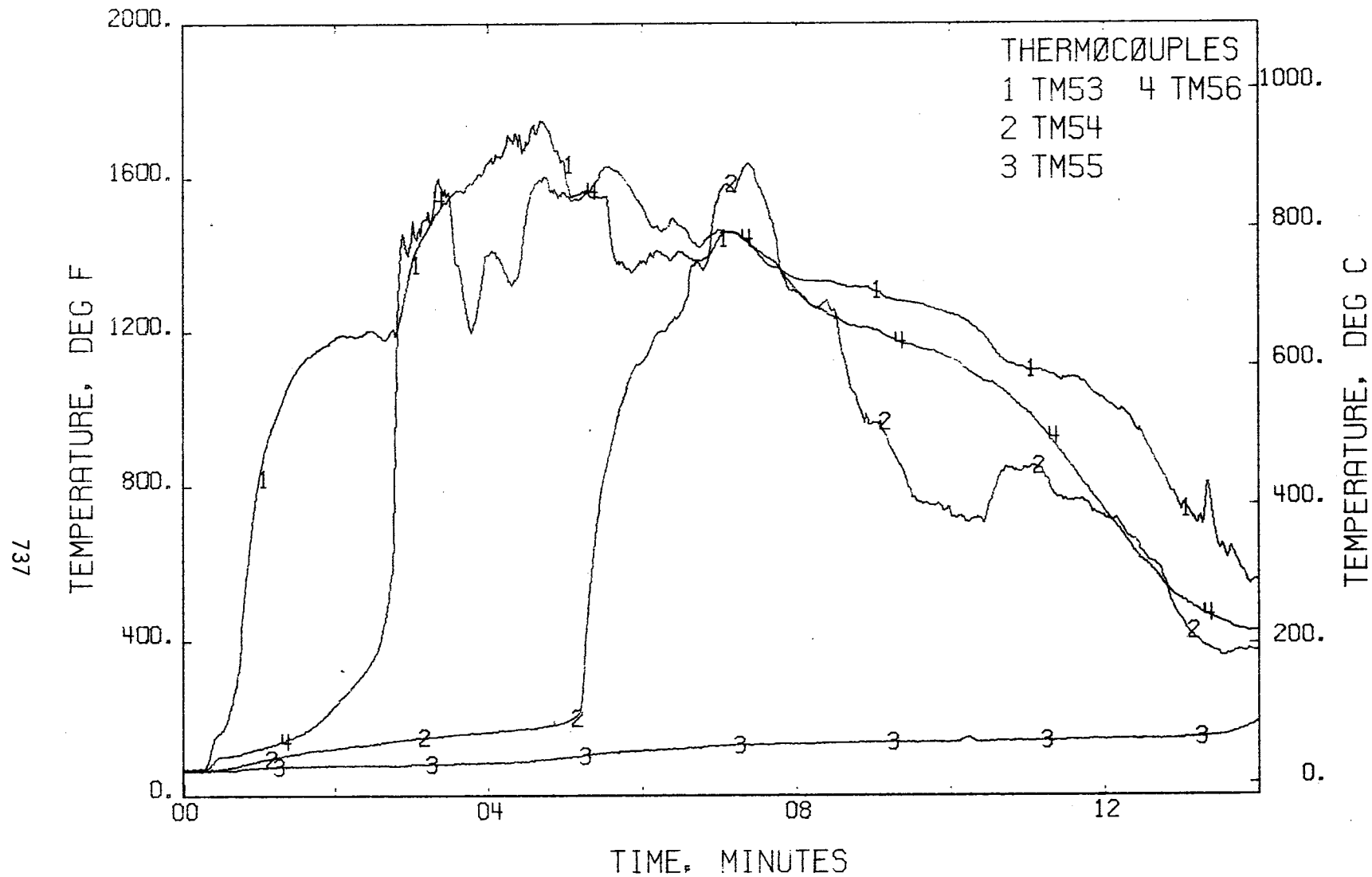


FIGURE 598 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 25

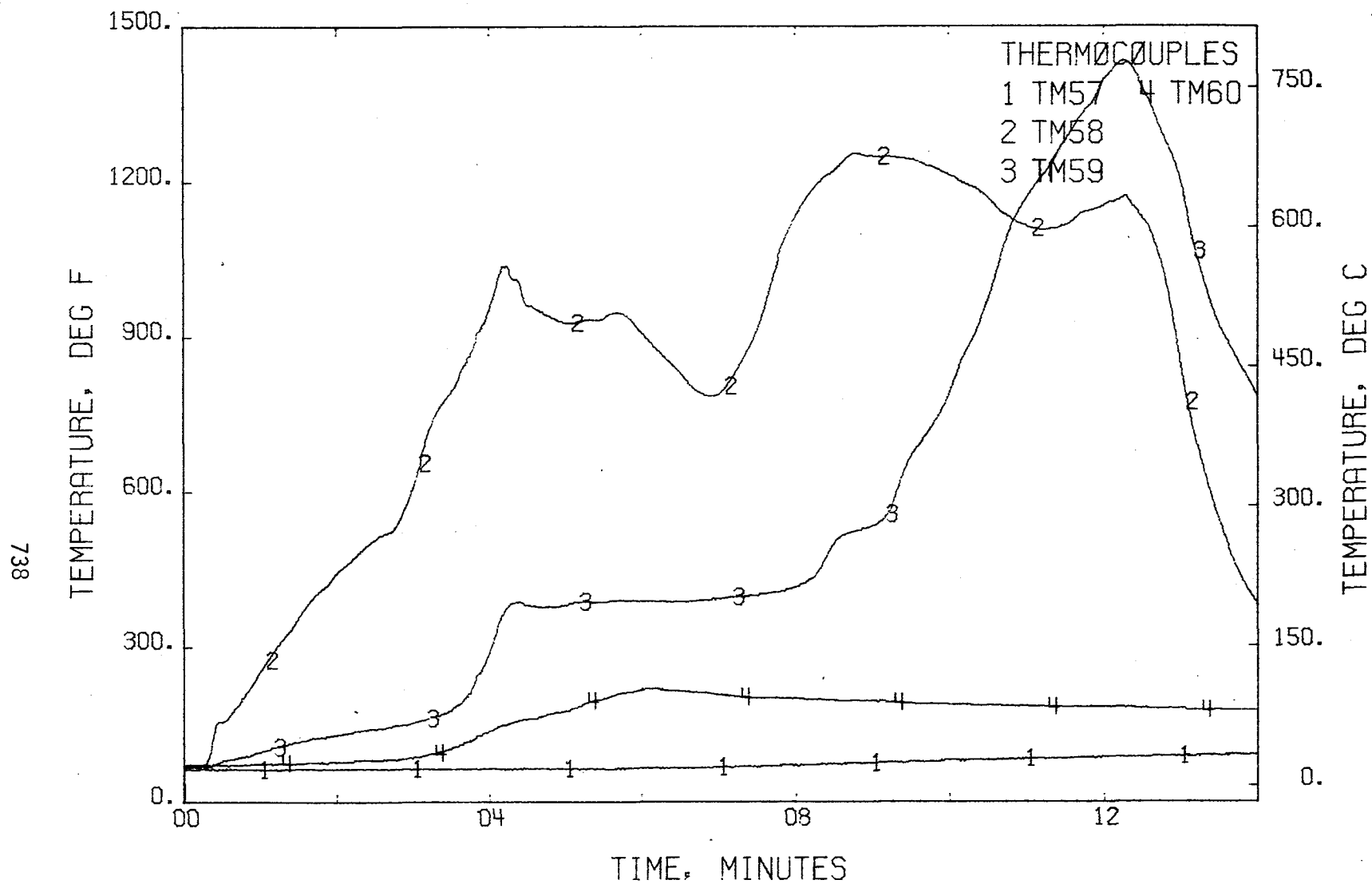


FIGURE 528 . - TEMPERATURES, SEAT CUSHIONS (EDGES)-CONT.  
TEST 25

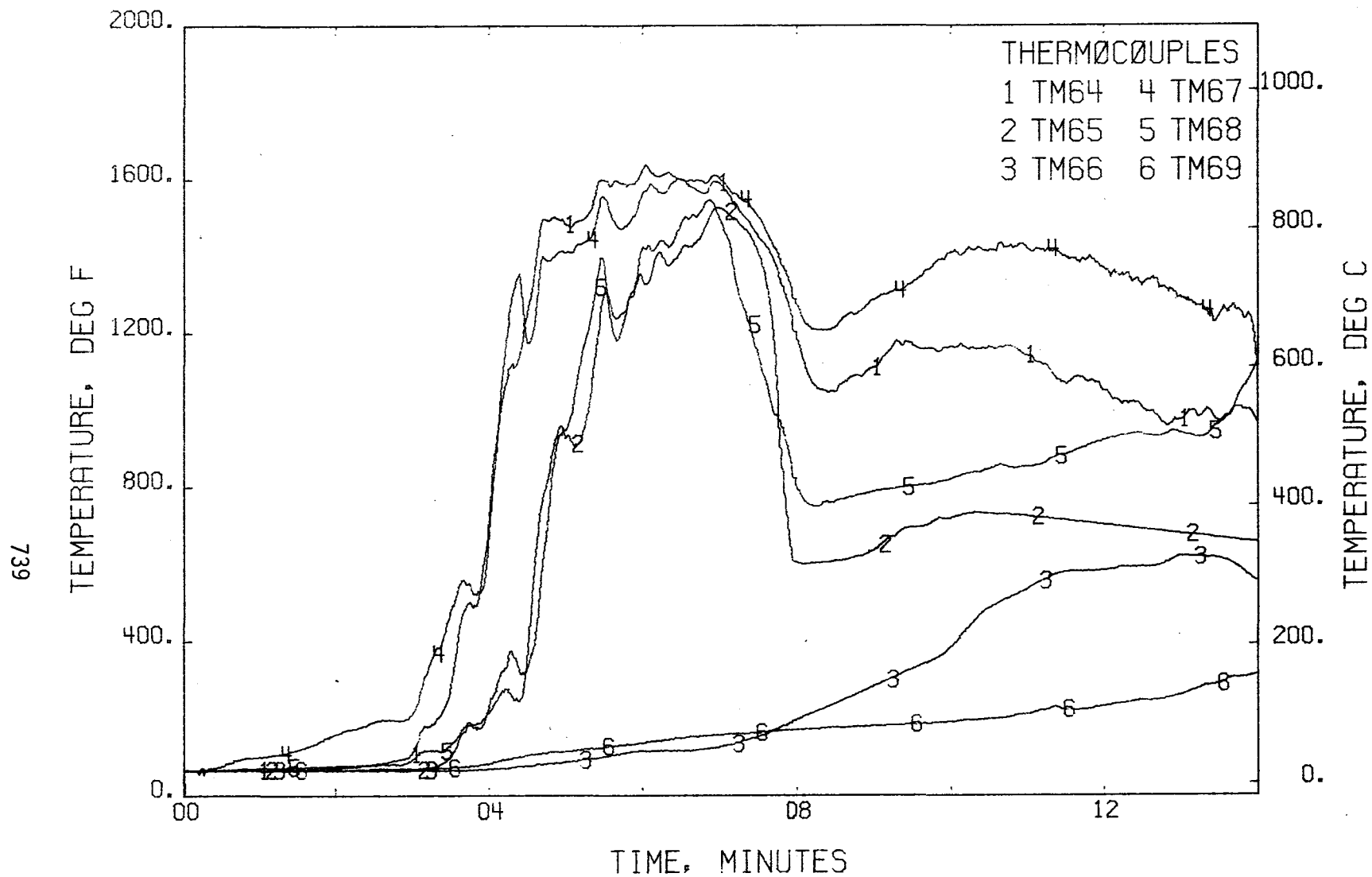


FIGURE 599 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 25

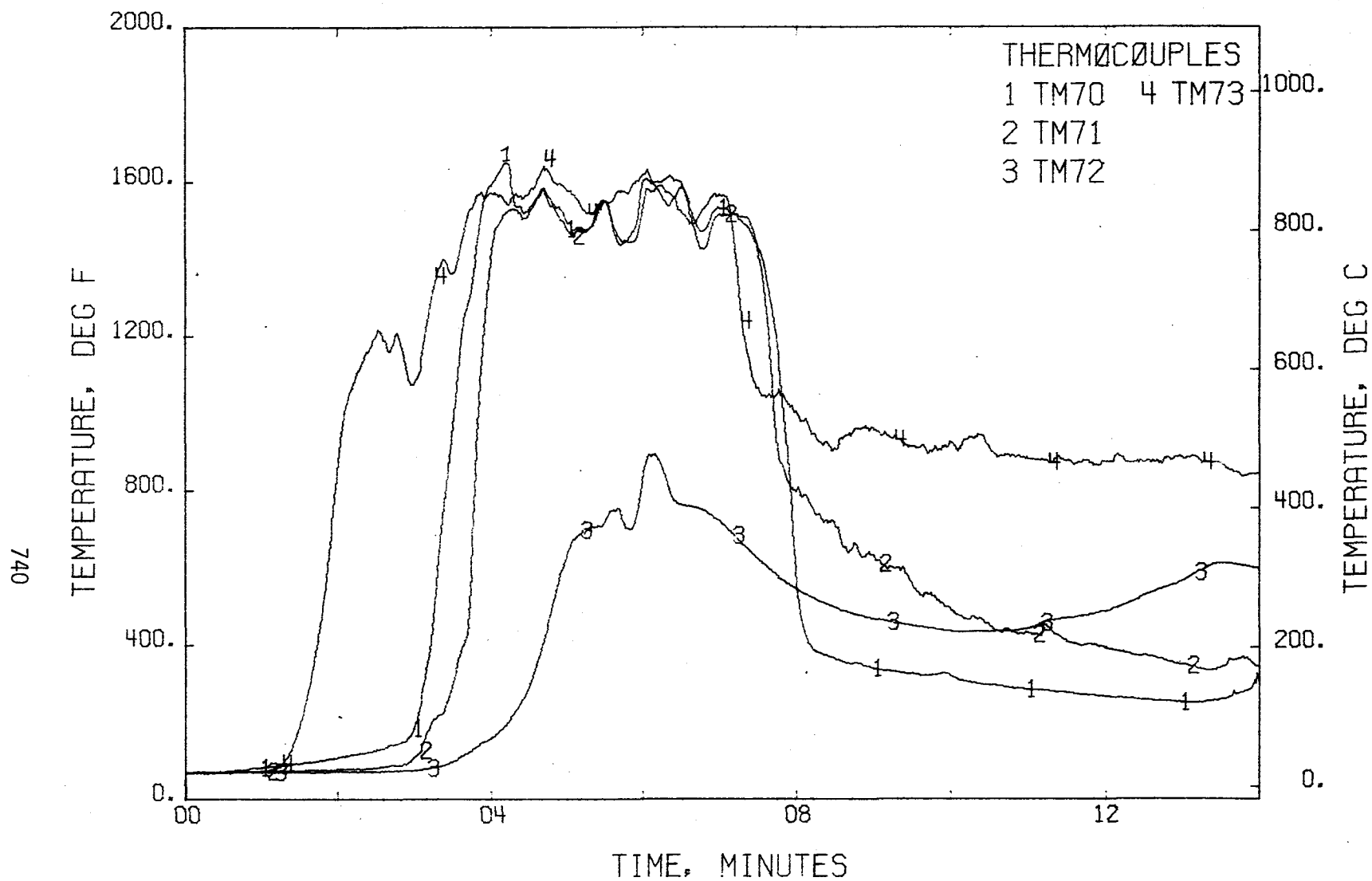


FIGURE 600 . - TEMPERATURES, SEAT BACKS (EDGES)  
TEST 25

741

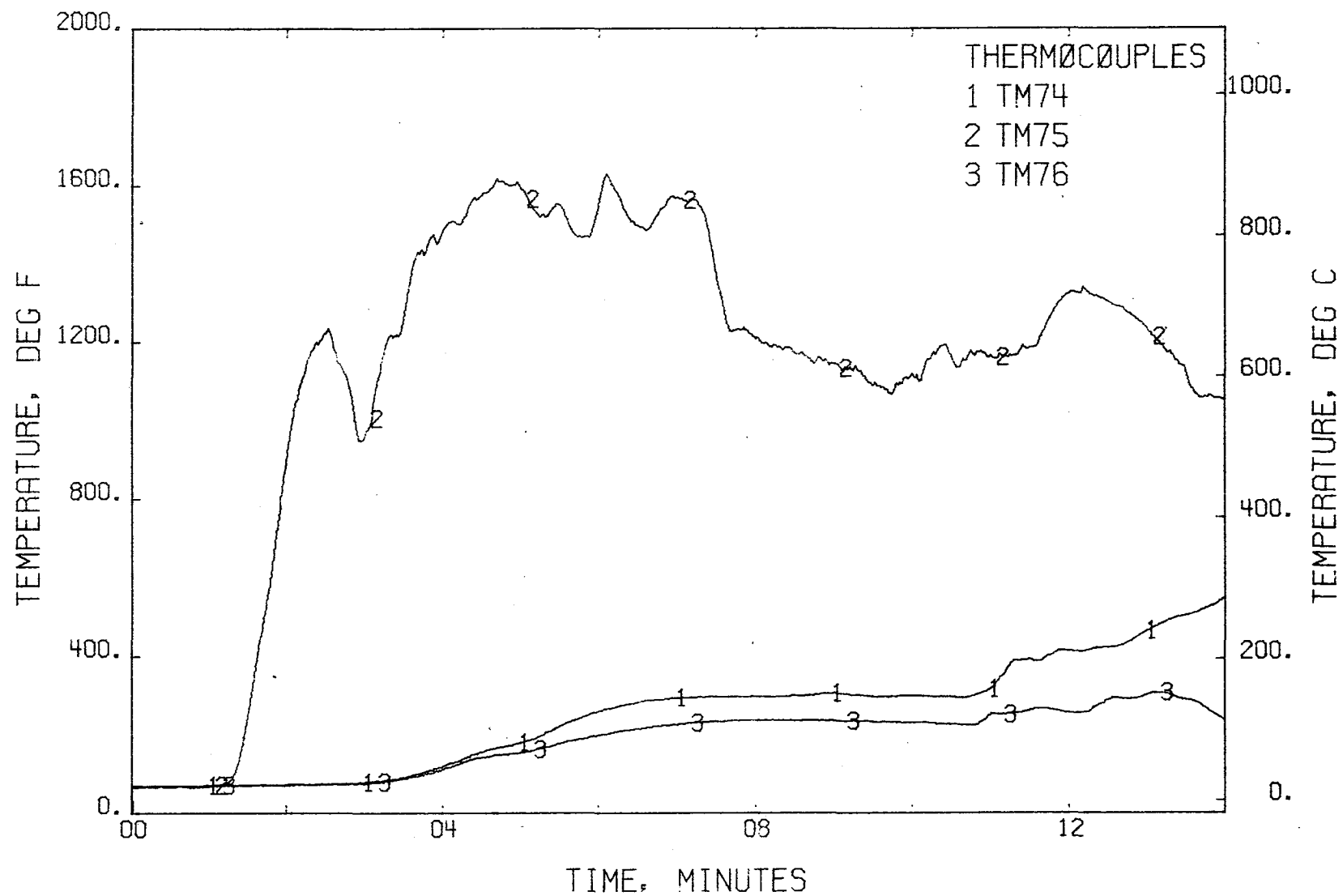


FIGURE 600 . - TEMPERATURES, SEAT BACK (EDGES)-CONT.  
TEST 25

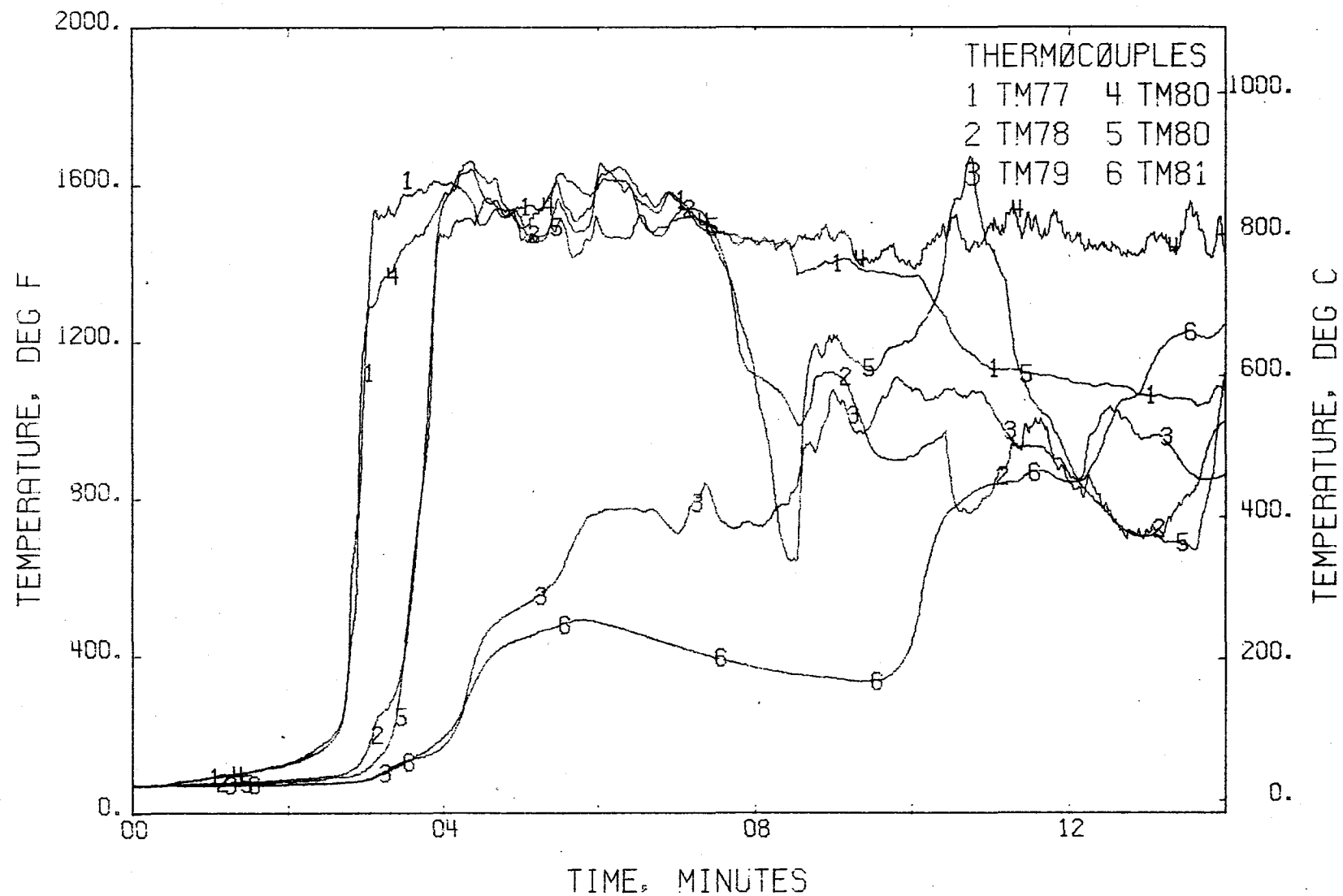


FIGURE 601 . - TEMPERATURES, SEAT BACKS (FRONT)  
TEST 25

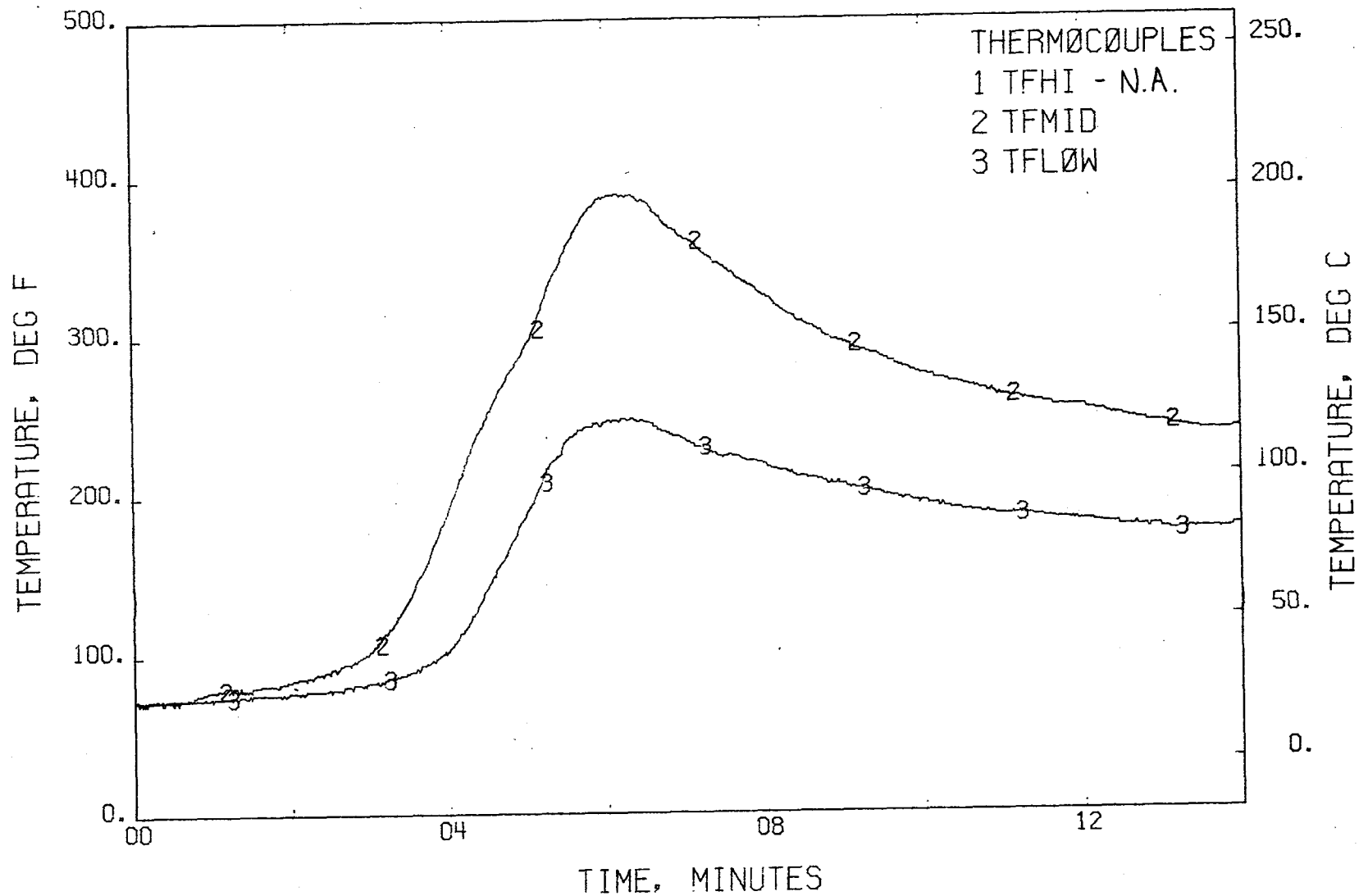


FIGURE 602 . - TEMPERATURES. ABOVE FUEL PAN  
TEST 25

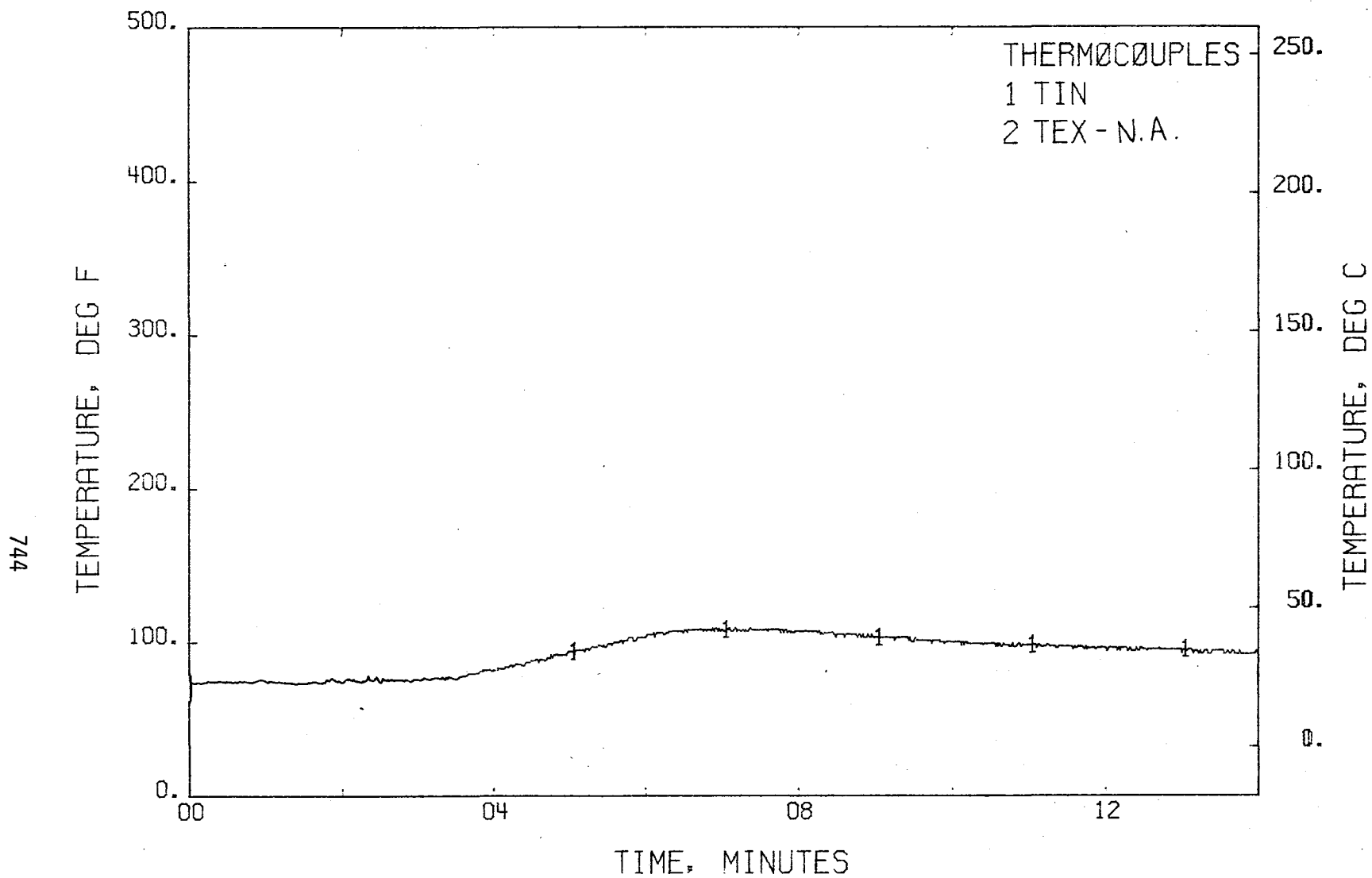


FIGURE 603 . - TEMPERATURES, INLET + EXIT  
TEST 25



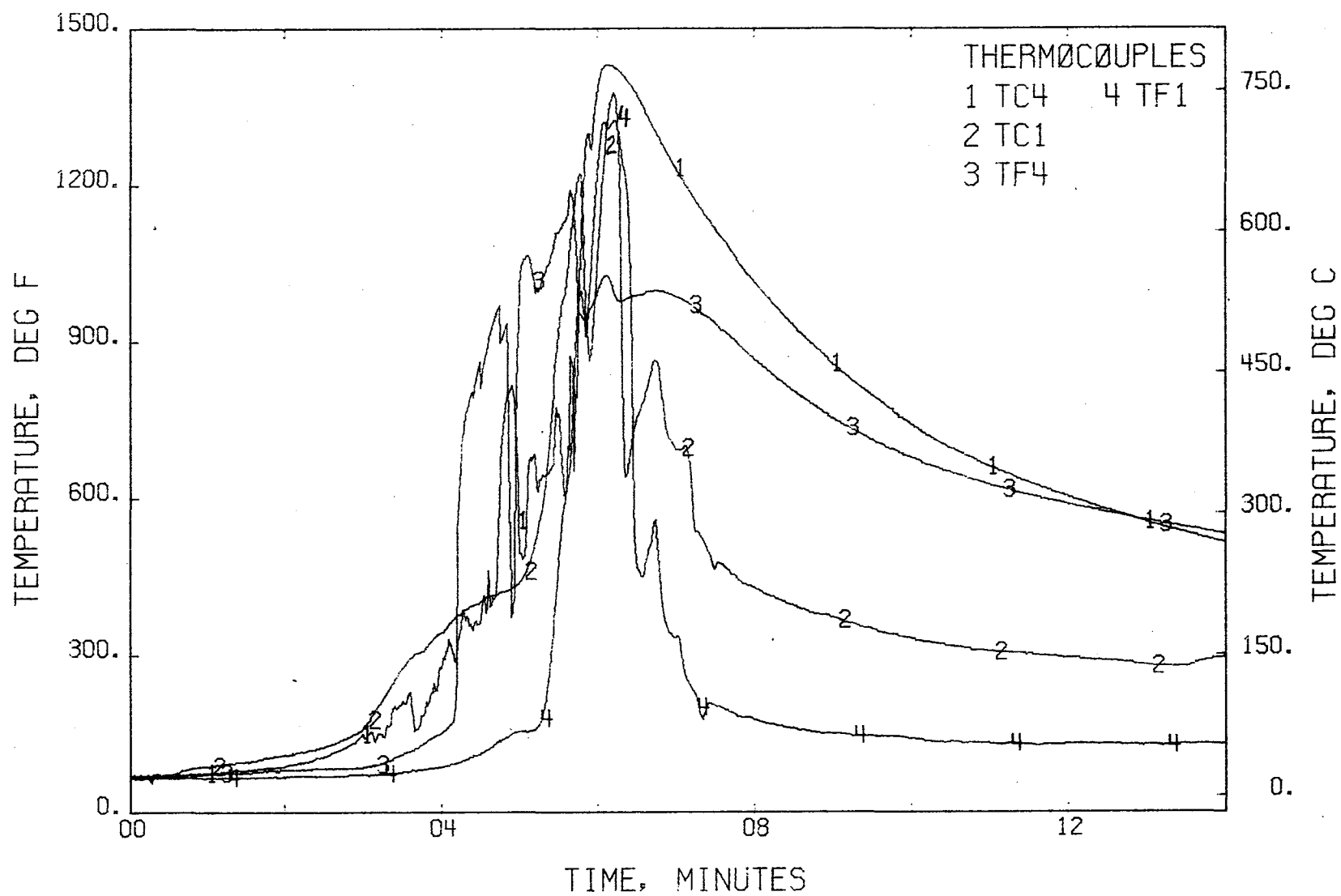


FIGURE 604 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 25

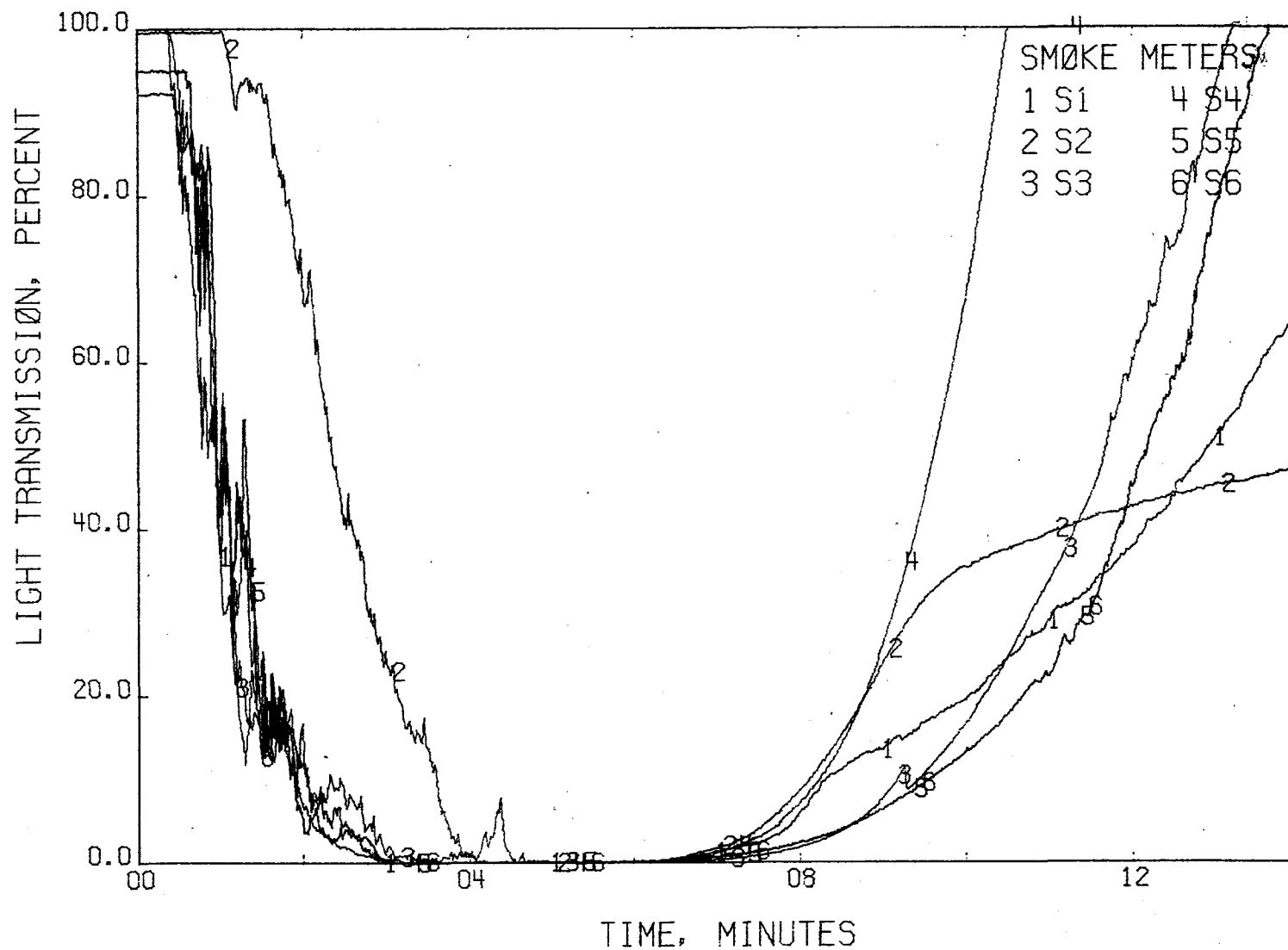


FIGURE 605 . - LIGHT TRANSMISSION  
TEST 25

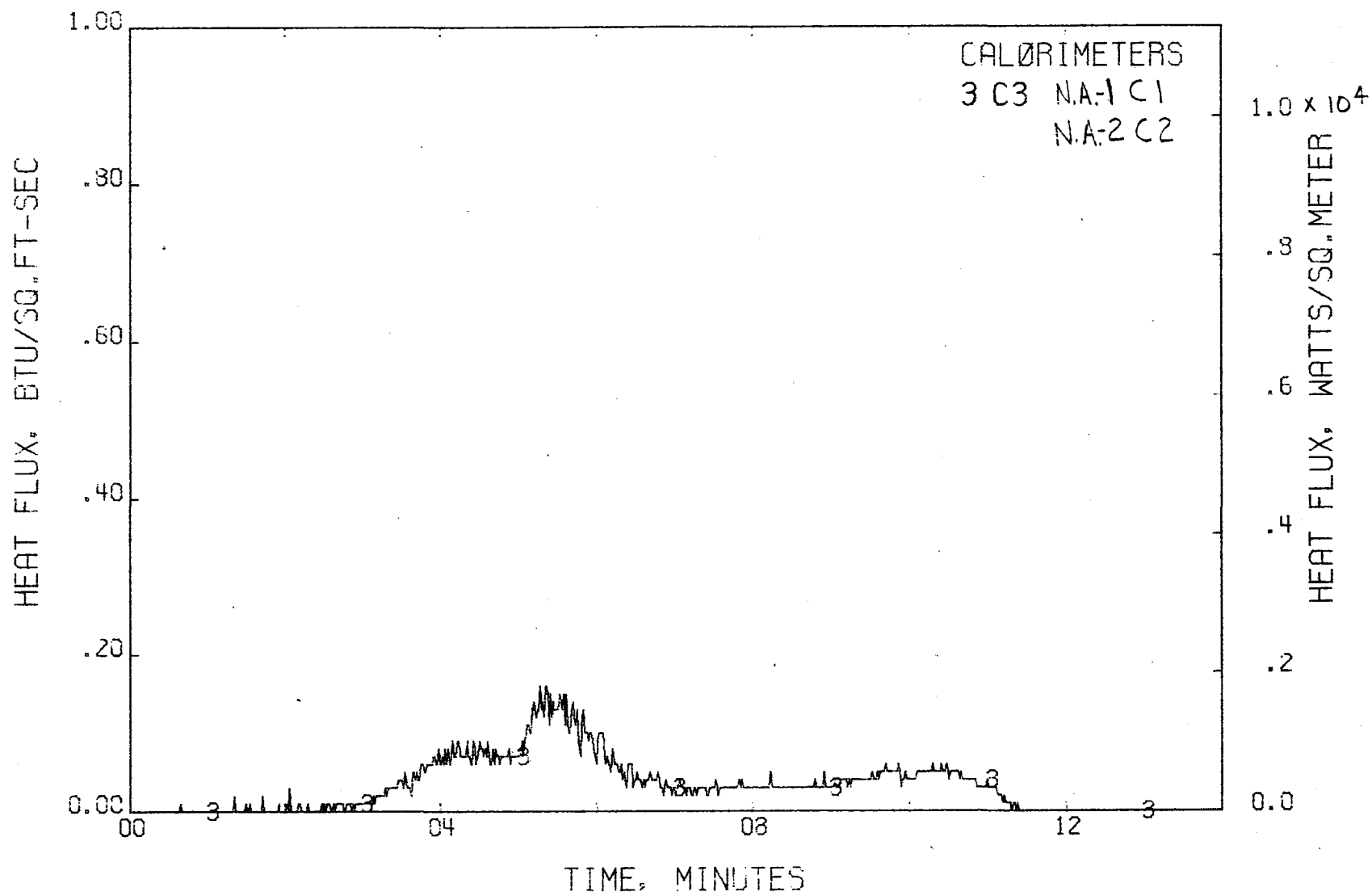


FIGURE 606 . - HEAT FLUX, AFT  
TEST 25

748

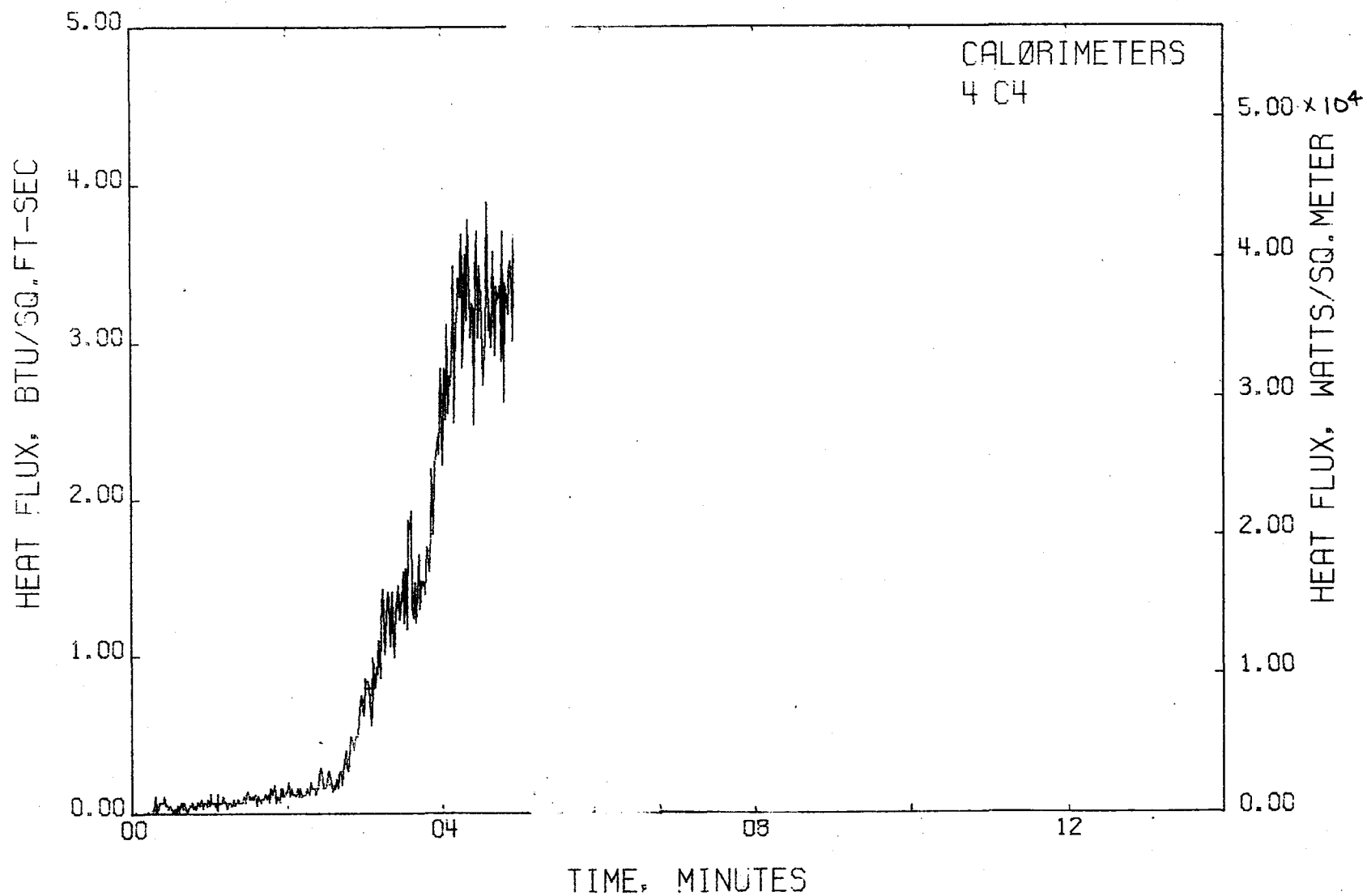


FIGURE 607 . - HEAT FLUX, MIDSECTION  
TEST 25

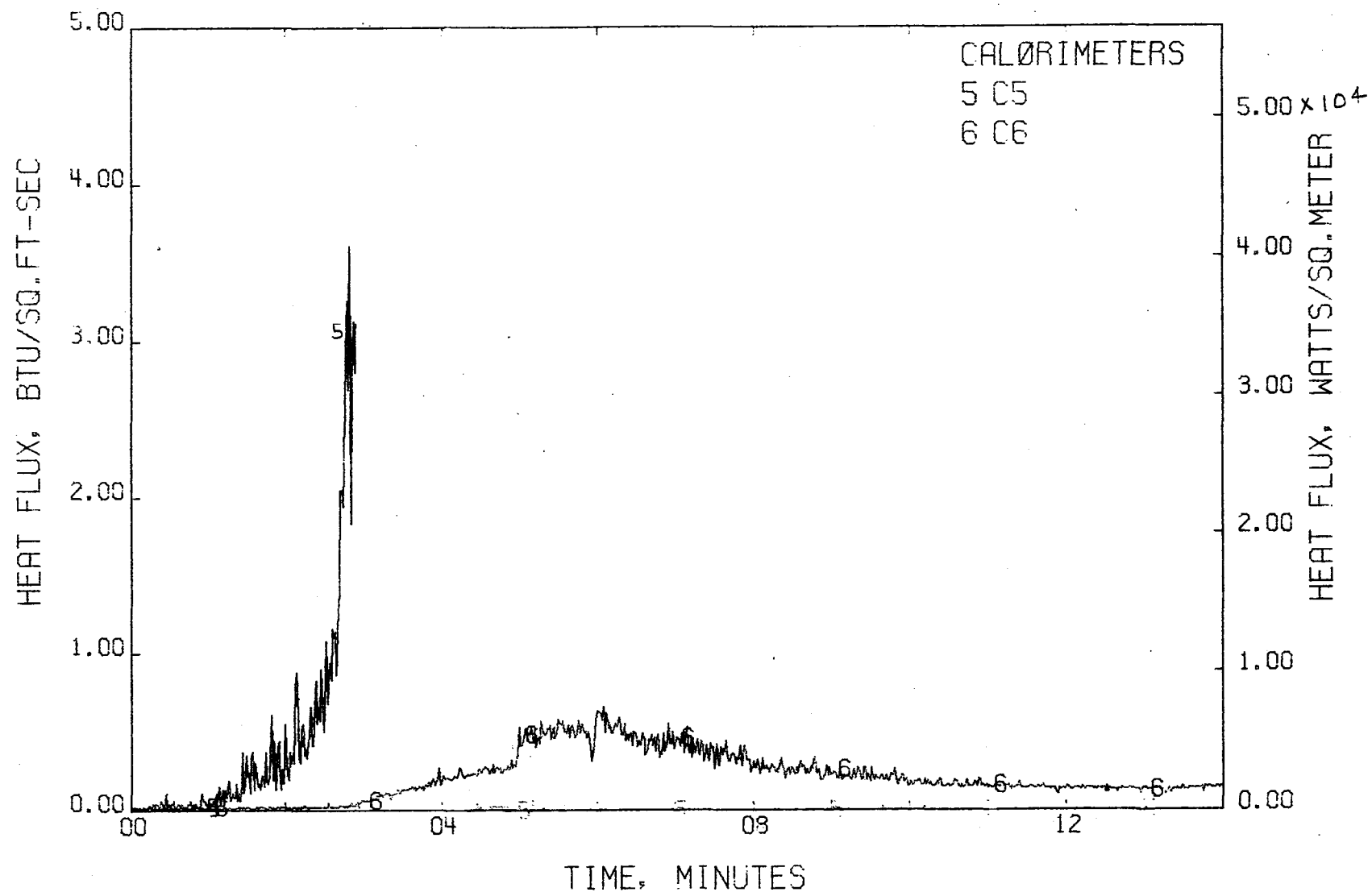


FIGURE 607. - HEAT FLUX, MIDSECTION - CONT.  
TEST 25

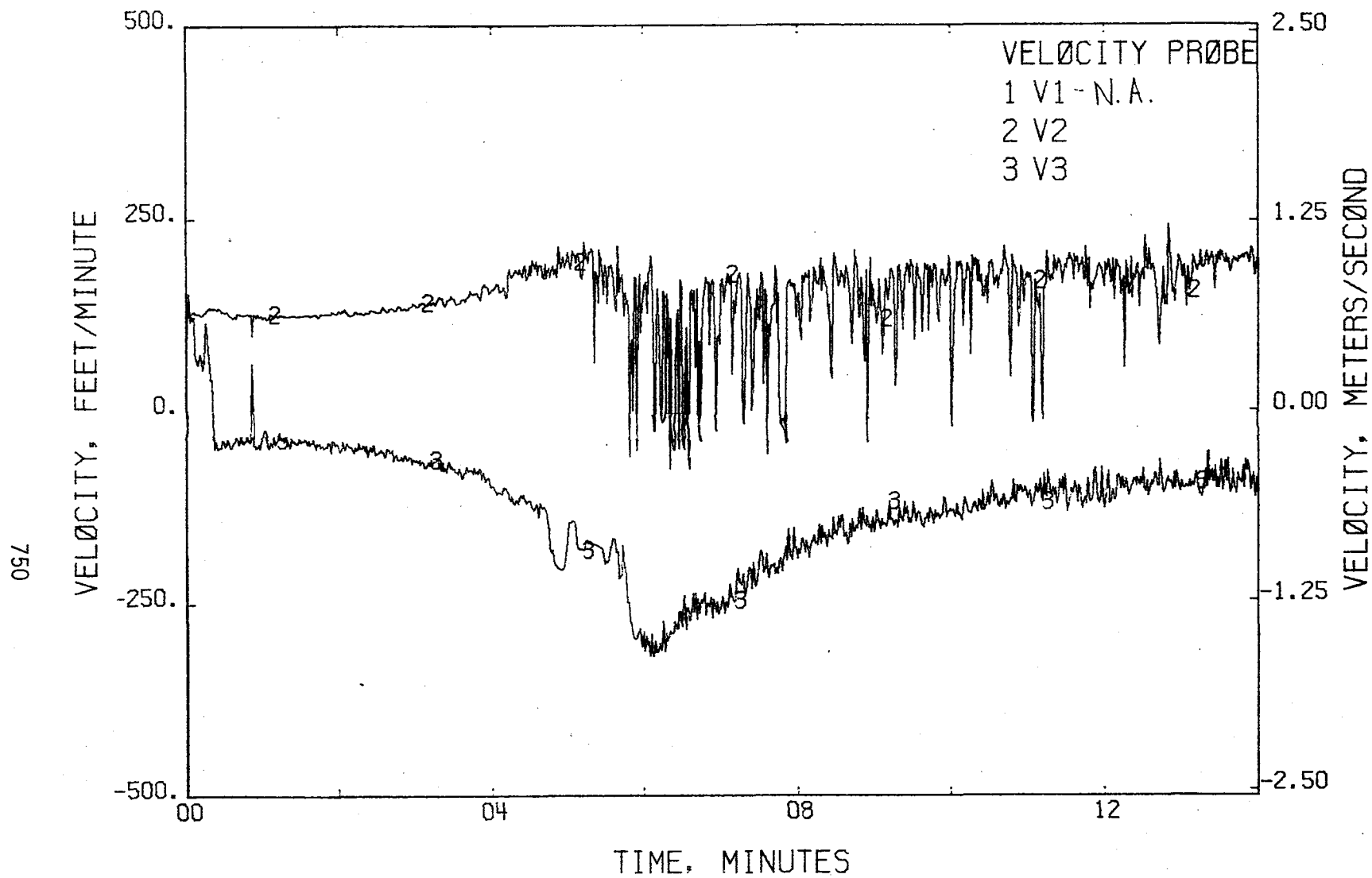


FIGURE 608 . - AIR VELOCITY  
TEST 25

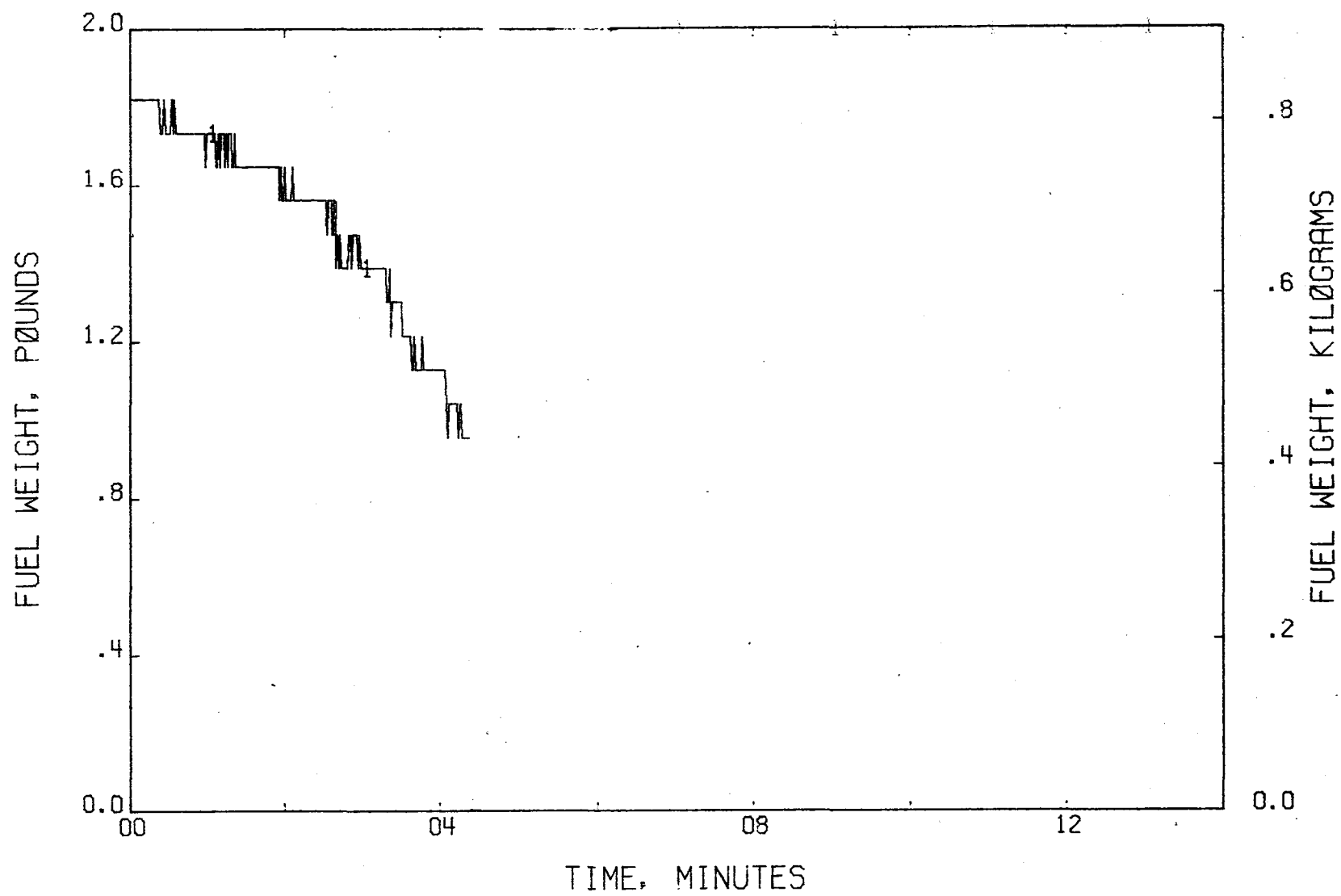


FIGURE 609 . - FUEL WEIGHT LOSS  
TEST 25

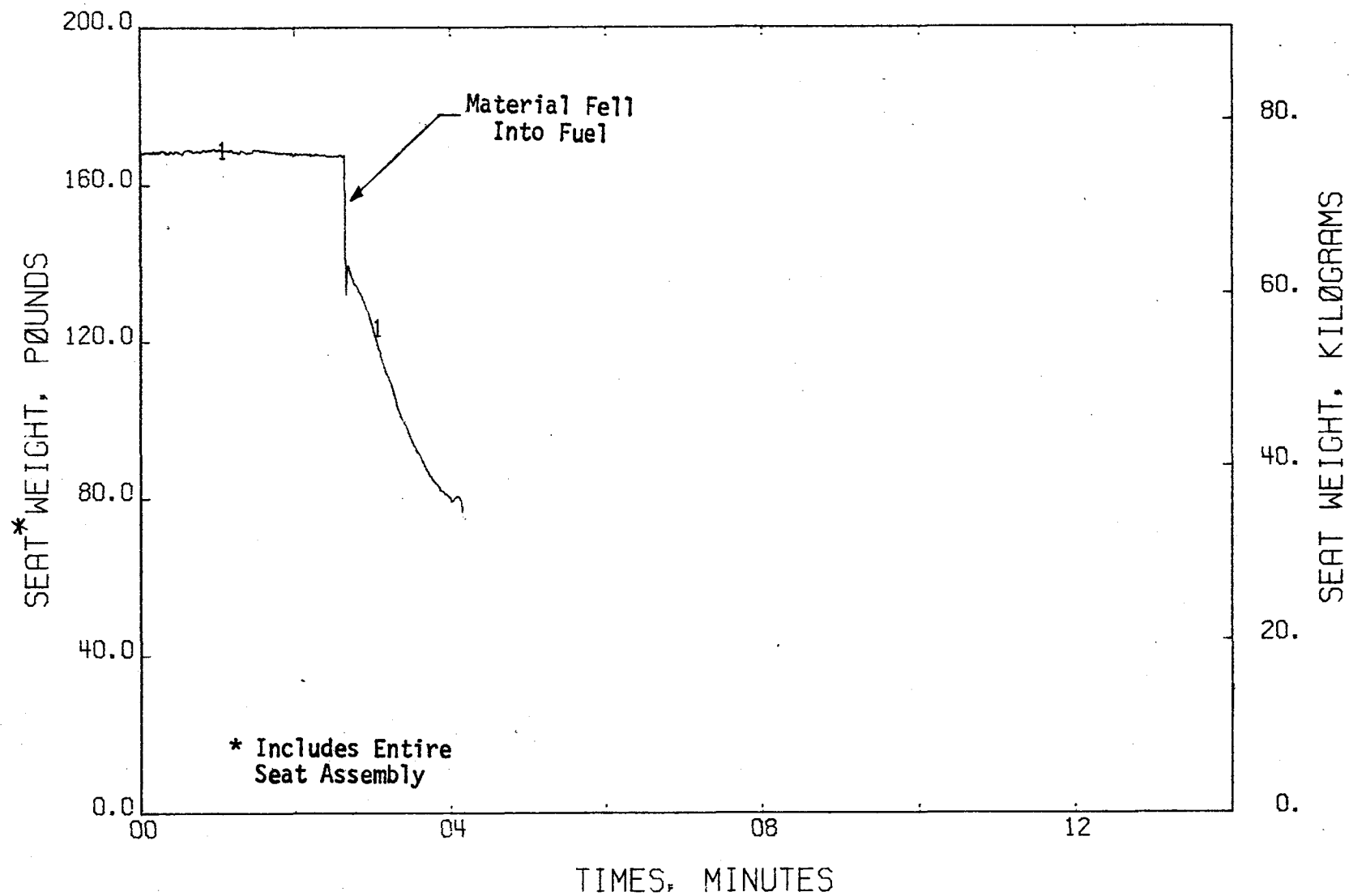


FIGURE 610 . - SEAT WEIGHT LOSS  
TEST 25



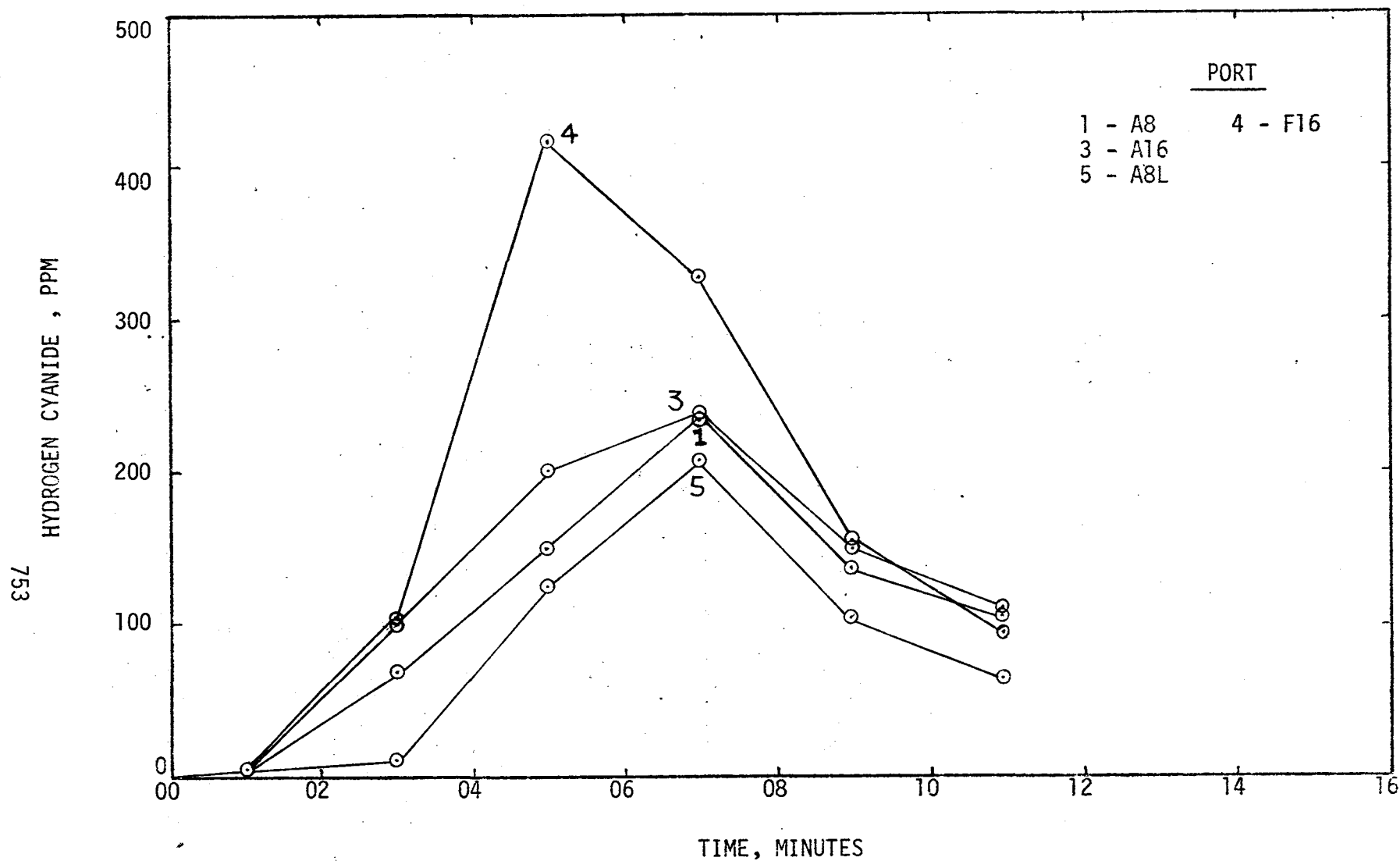


FIGURE 611 : - HYDROGEN CYANIDE CONCENTRATIONS  
TEST 25

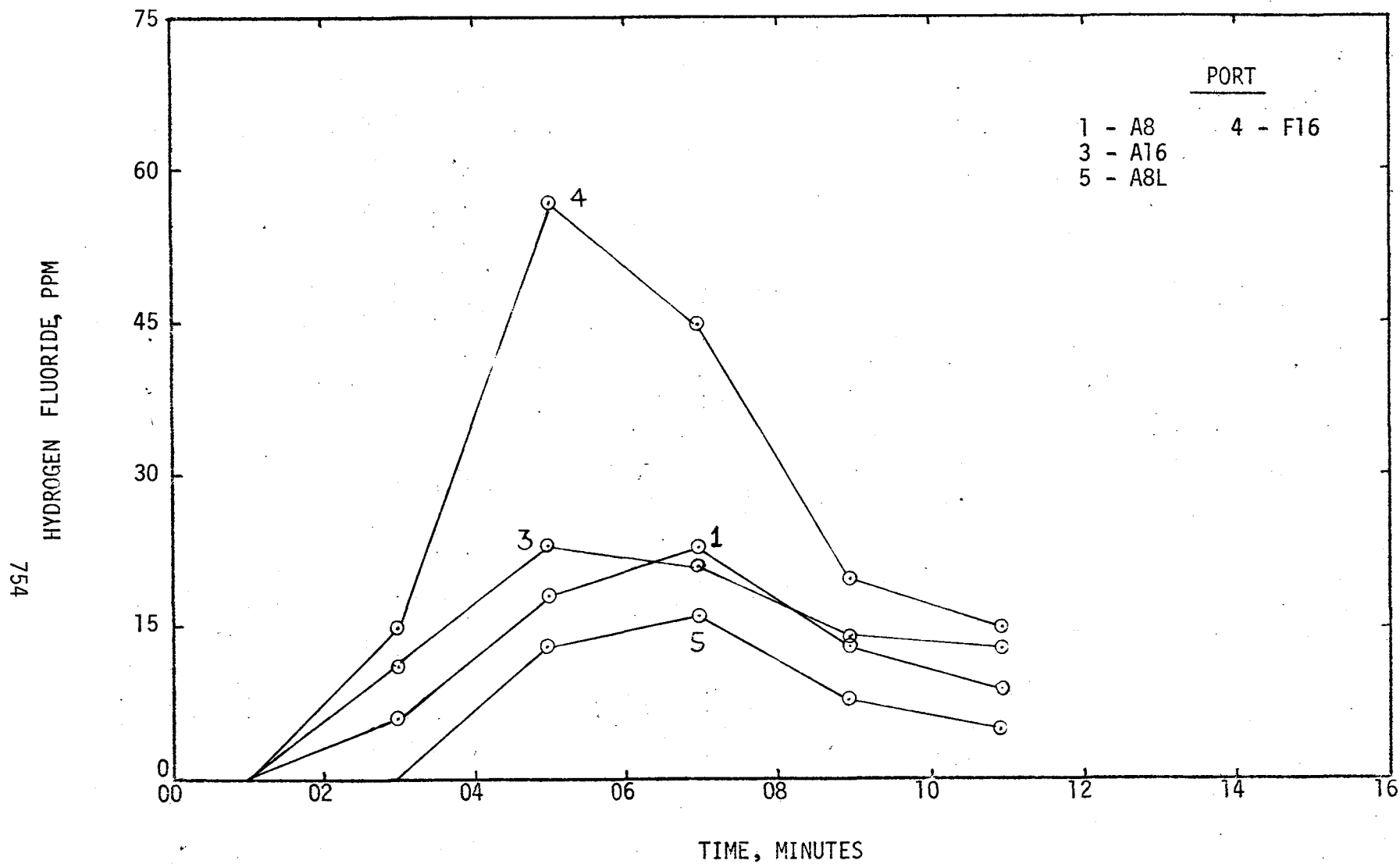


FIGURE 612 : - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 25

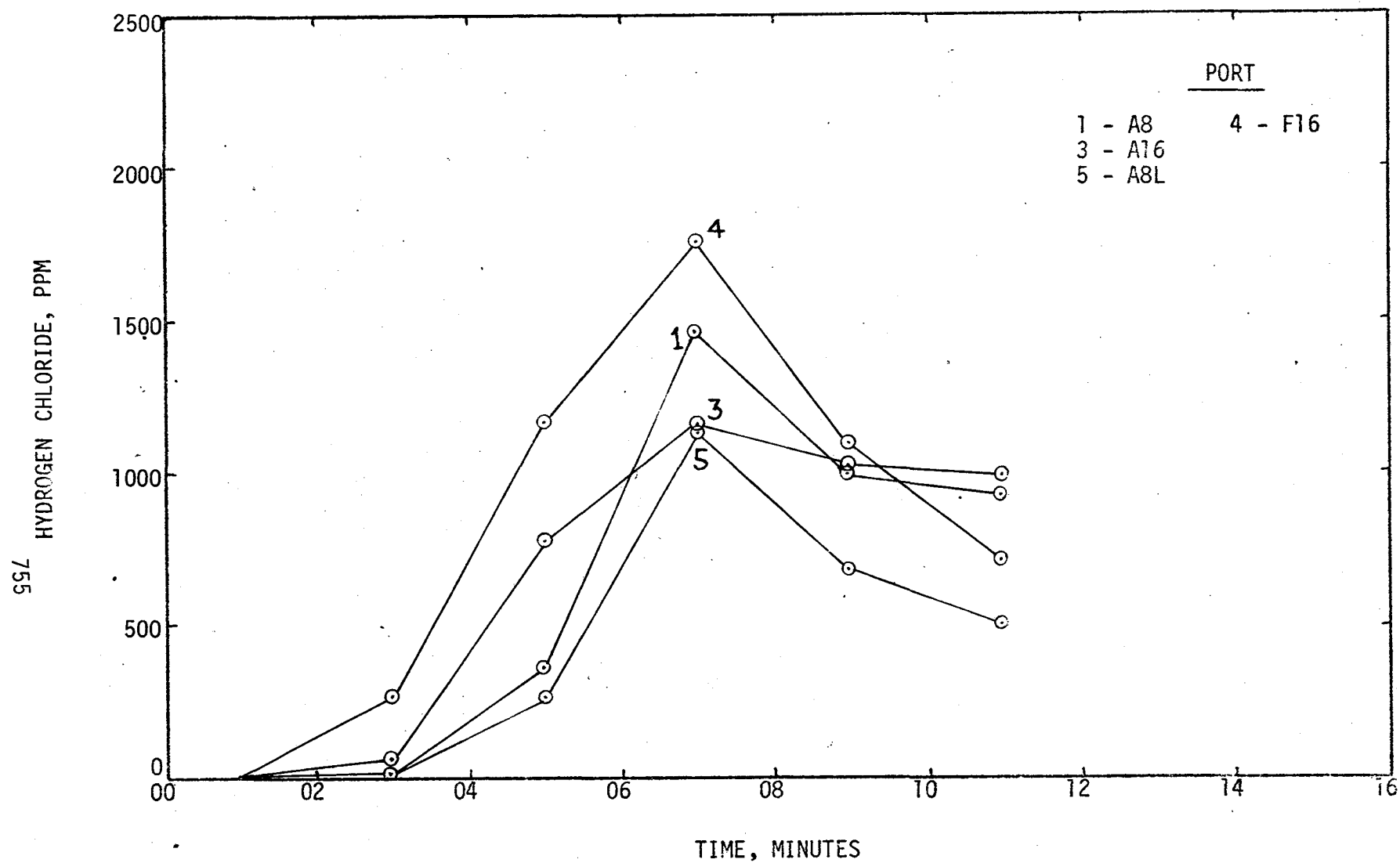


FIGURE 613 : - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 25

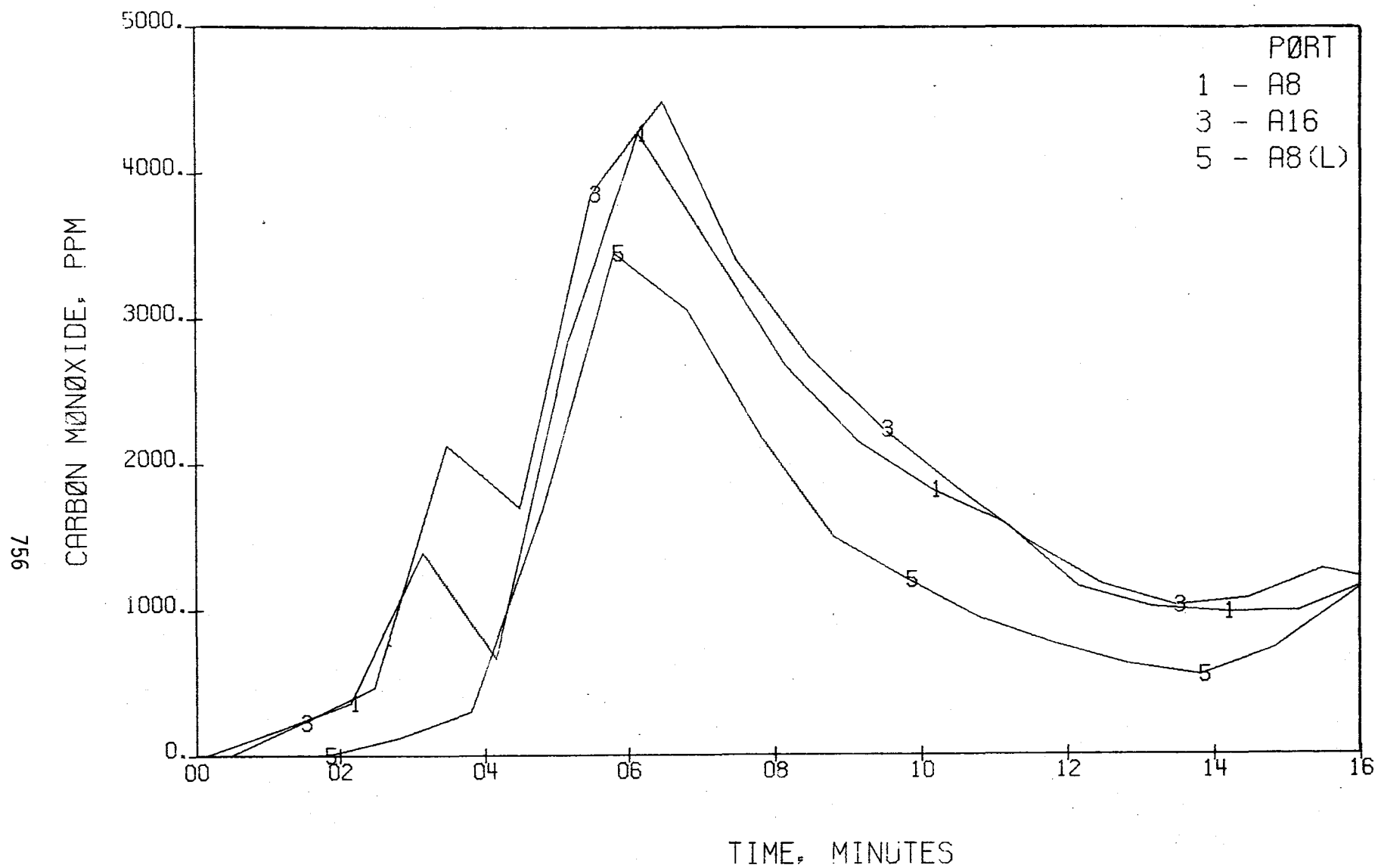


FIGURE 614 .- CARBON MONOXIDE CONCENTRATIONS , AFT  
TEST 25

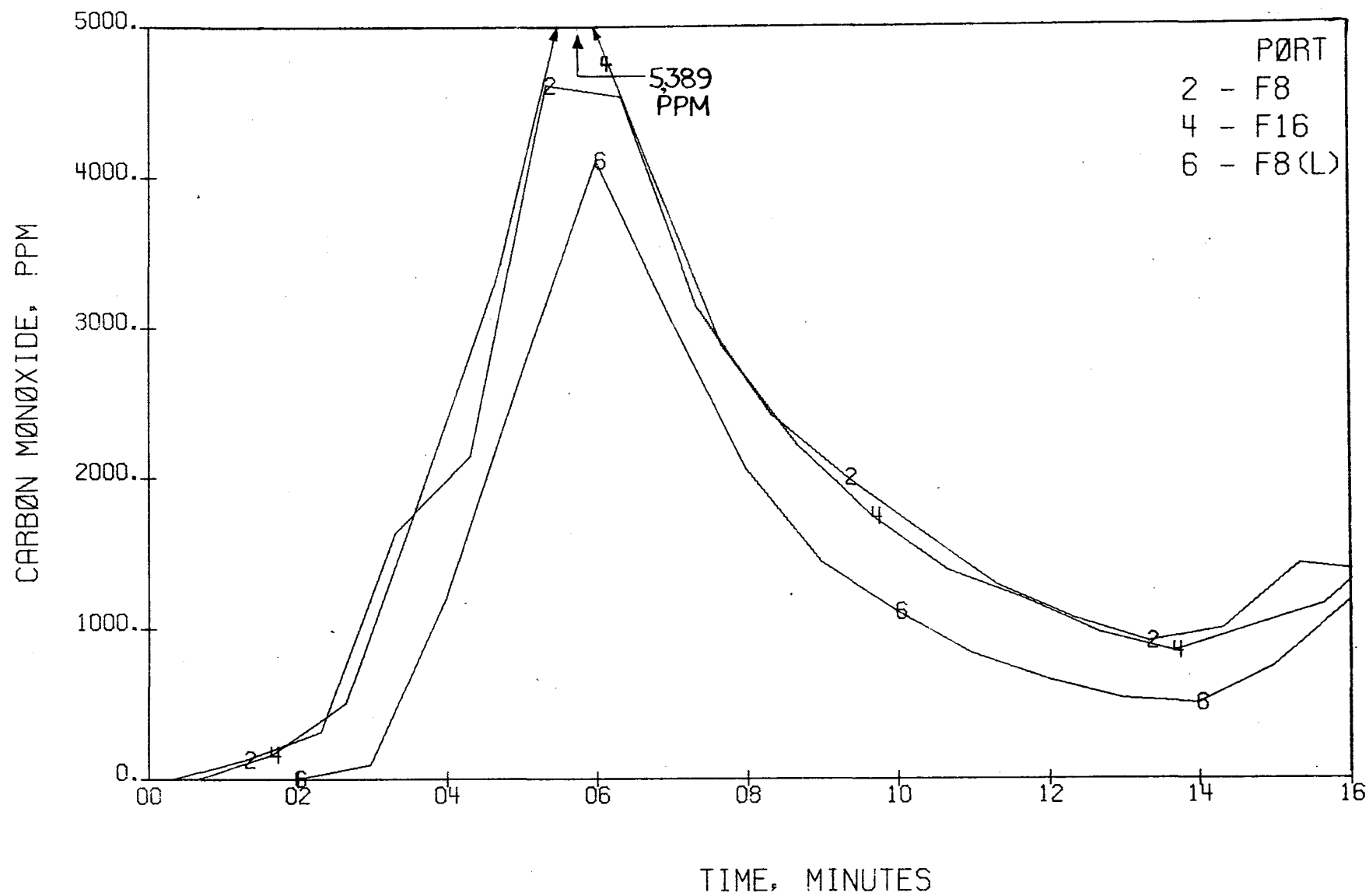


FIGURE 615 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 25

CARBON DIOXIDE, PERCENT

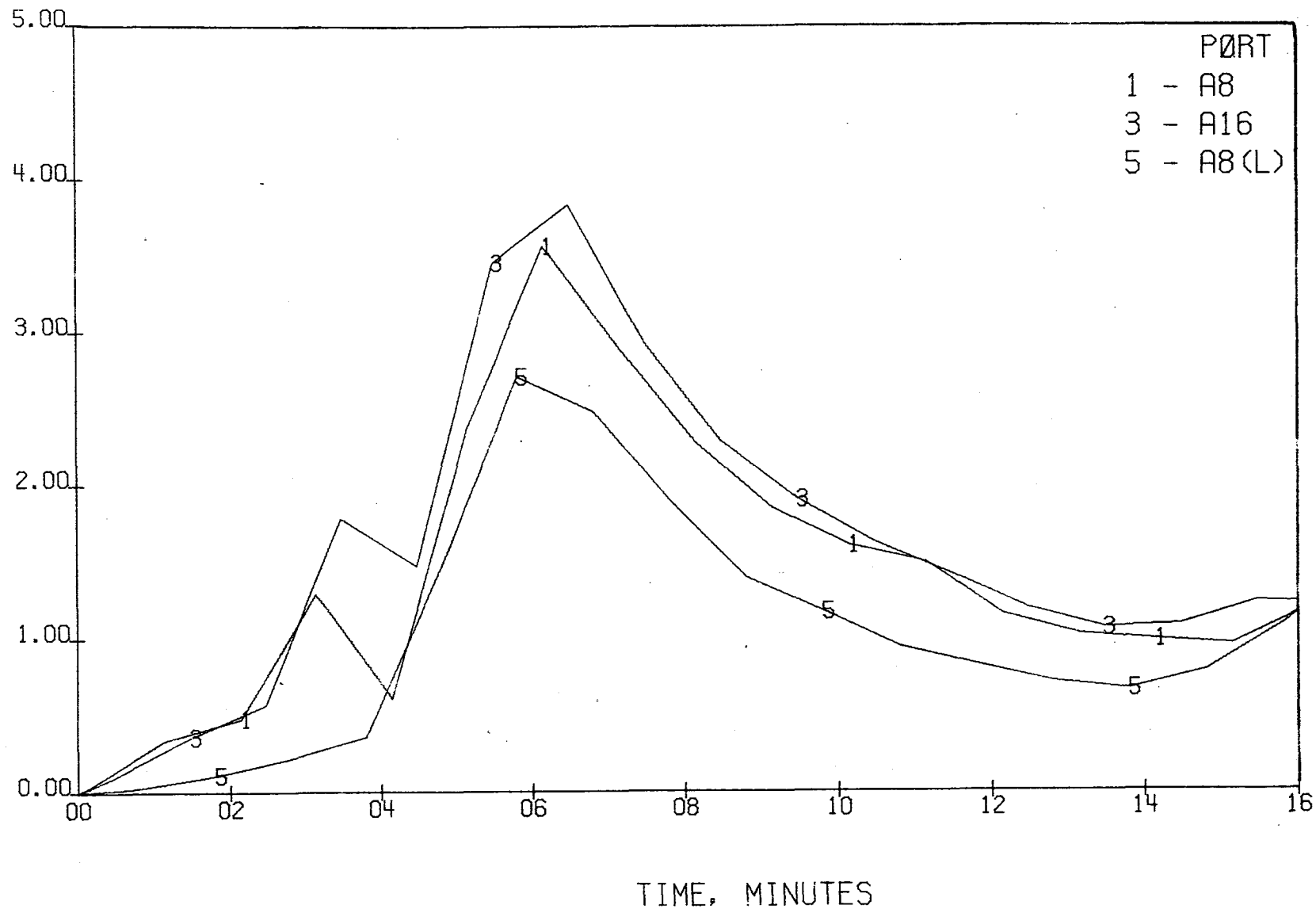


FIGURE 616 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 25

759

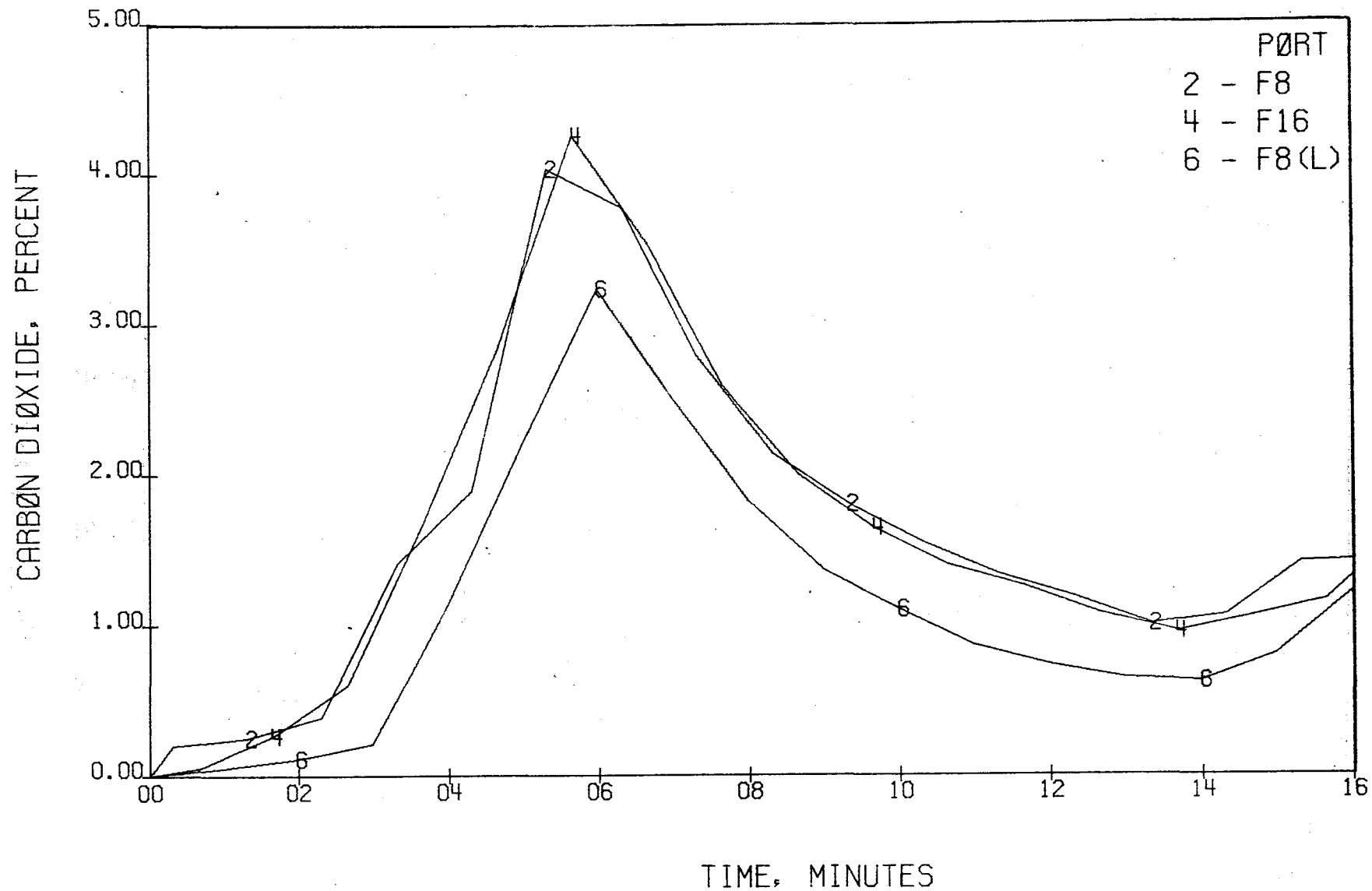


FIGURE 617 .- CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 25

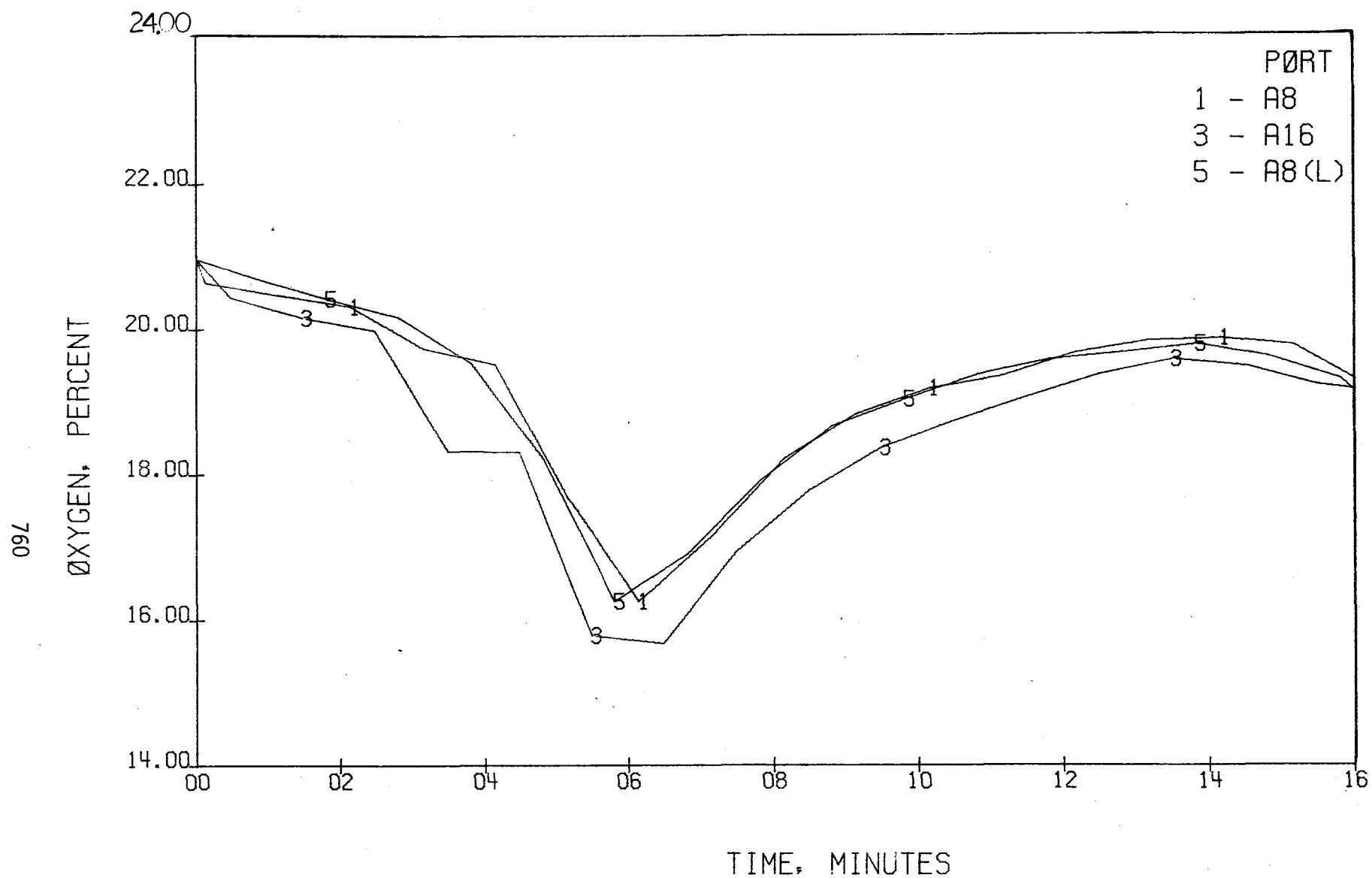


FIGURE 618 . - OXYGEN CONCENTRATIONS , AFT  
TEST 25



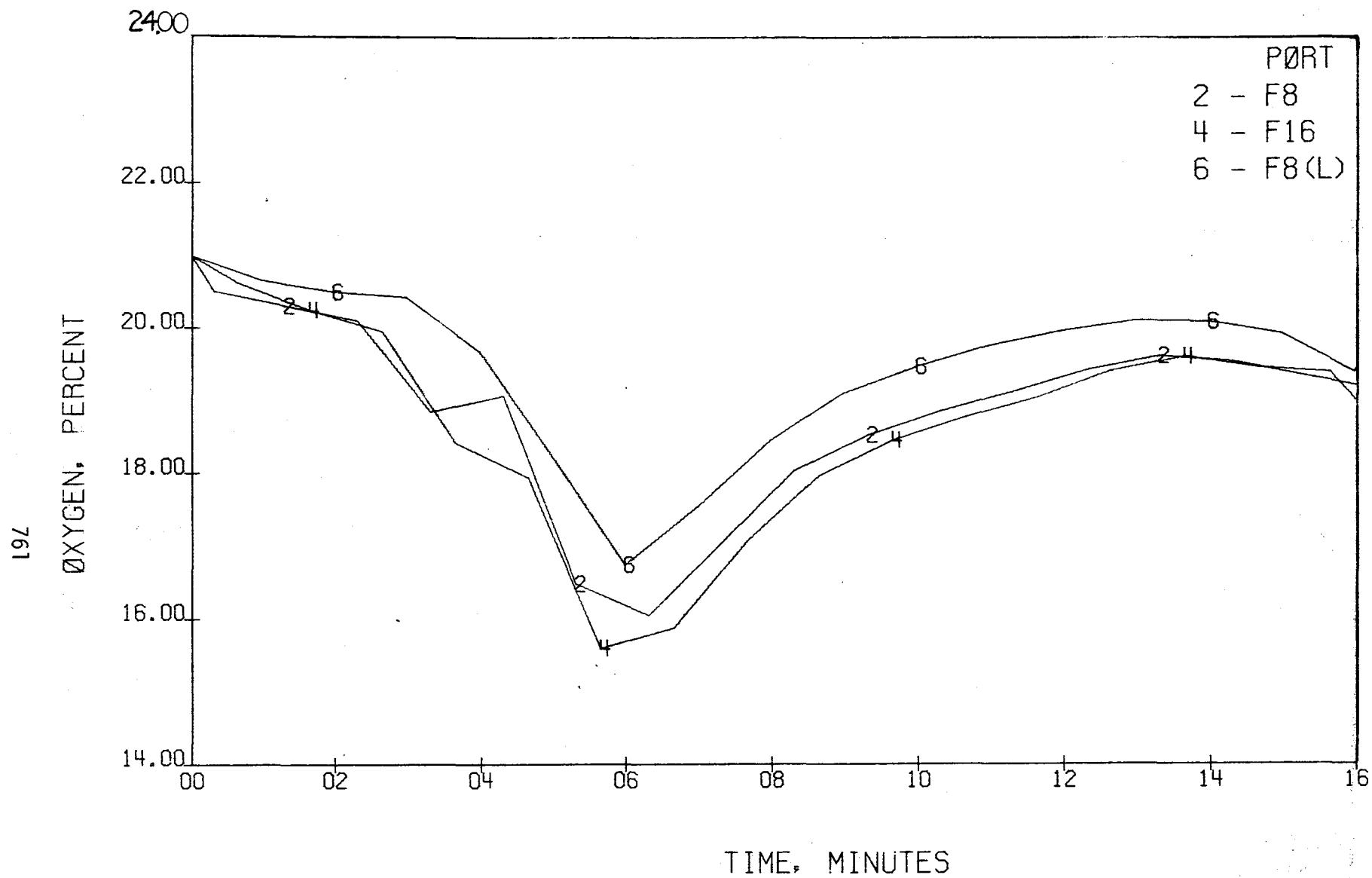


FIGURE 619 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 25

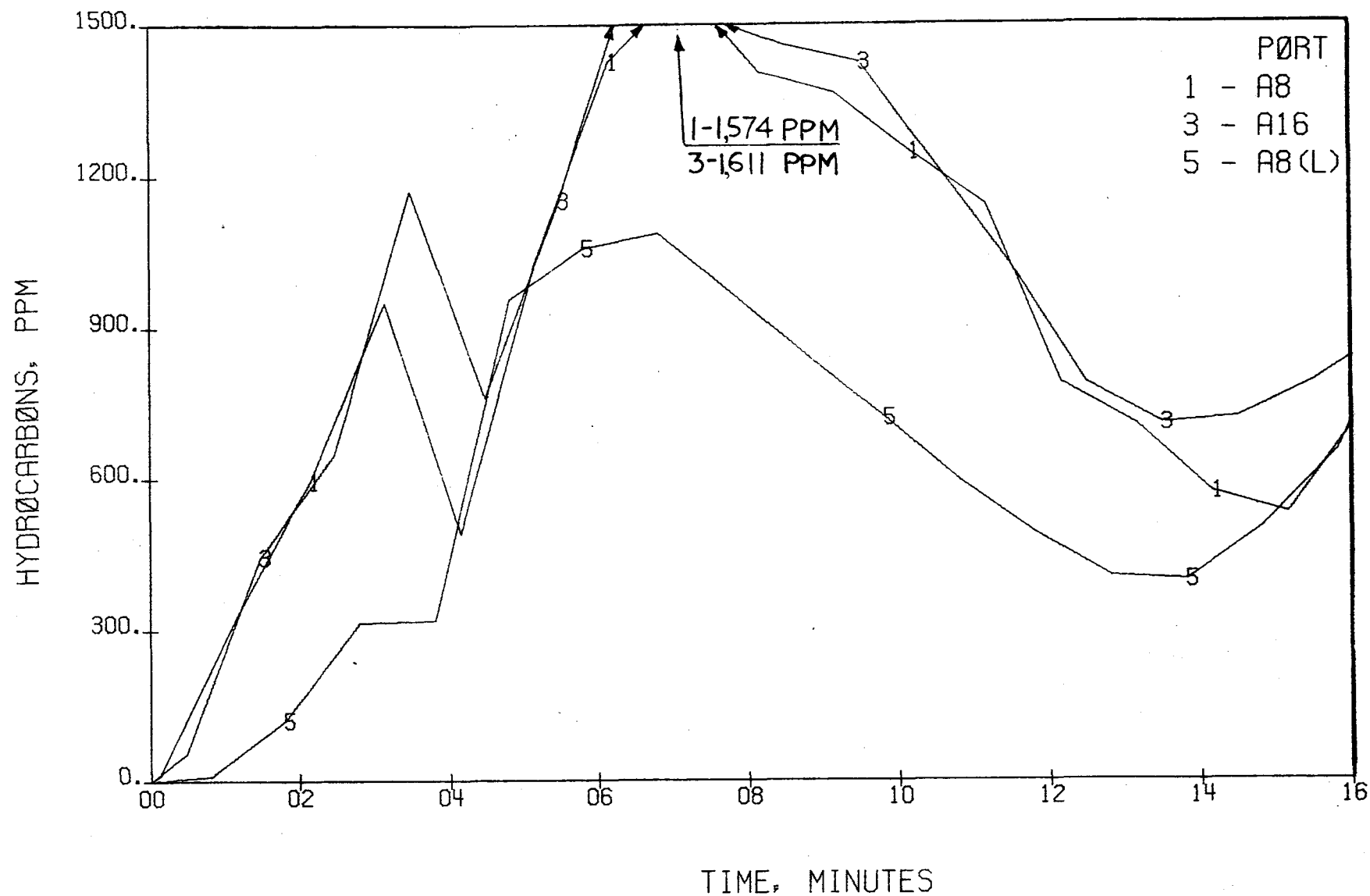


FIGURE 620 . - HYDROCARBONS CONCENTRATIONS, AFT  
TEST 25

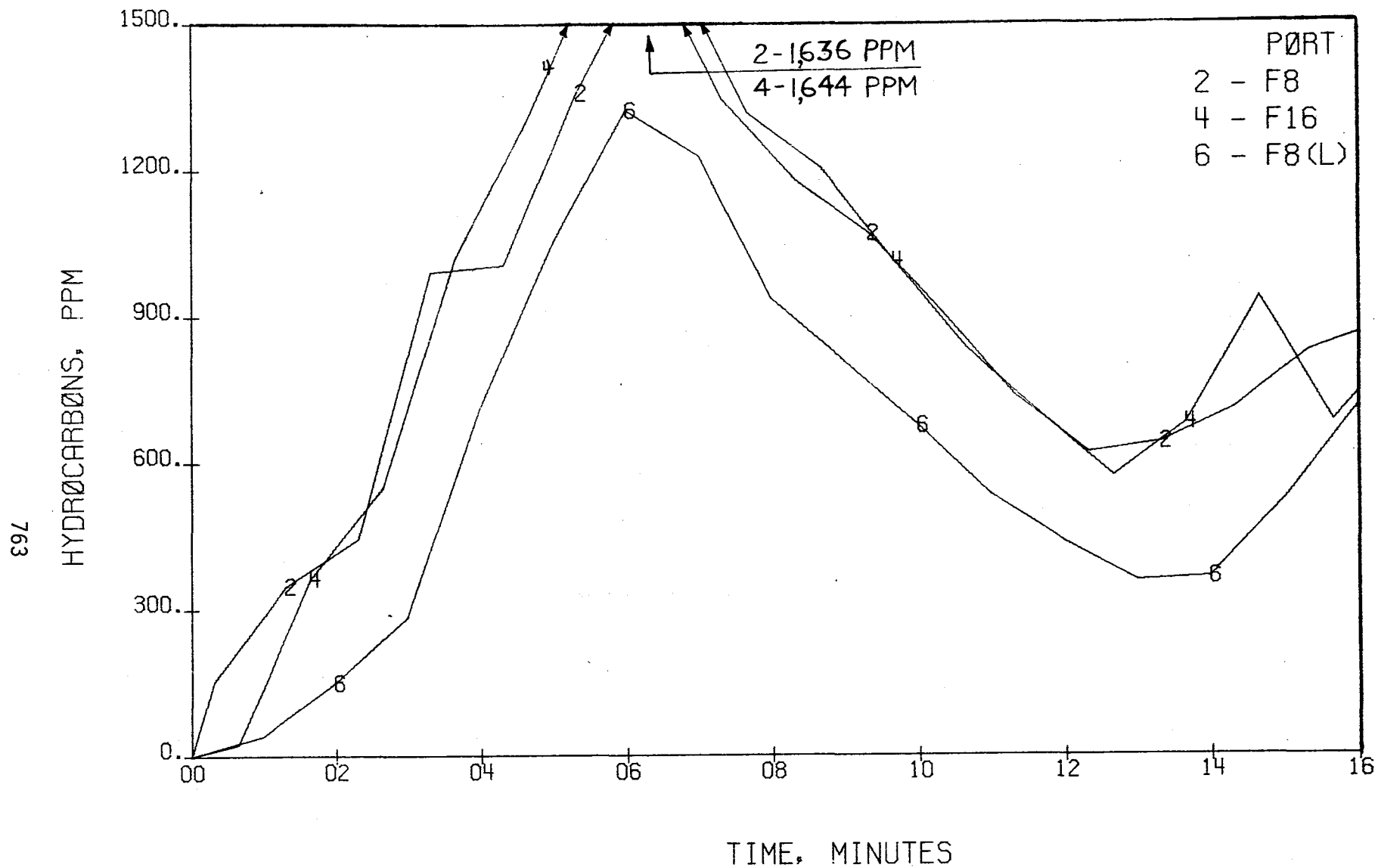


FIGURE 621 .- HYDROCARBONS CONCENTRATIONS , FØRE  
TEST 25



TEST 26  

---

FUEL ONLY

TEST 26

---

FUEL ONLY

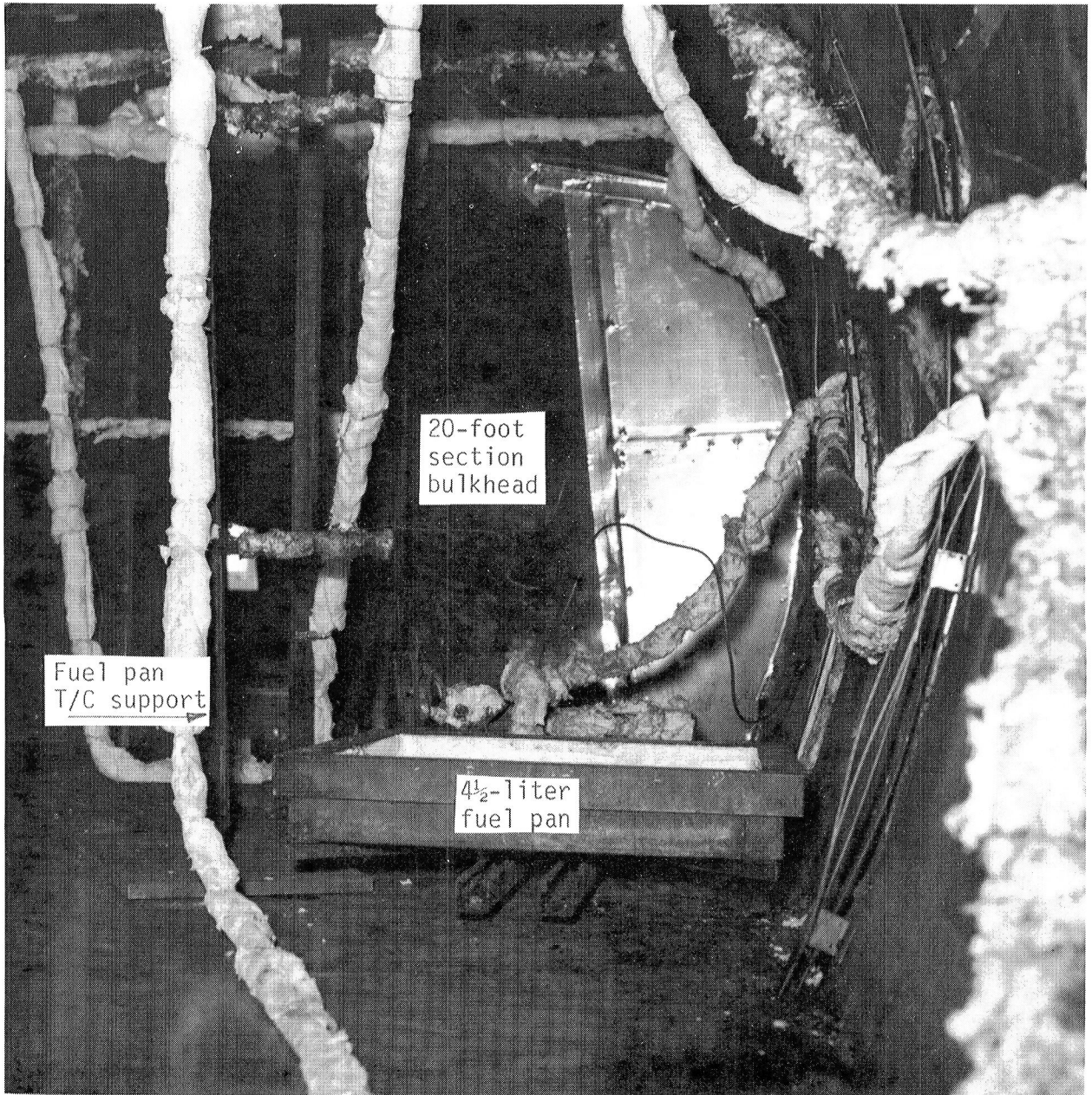


FIGURE 622 , - PRE-TEST CONFIGURATION, TEST 26



FIGURE 623 . - POST-TEST CONFIGURATION, TEST 26





FIGURE 624 . - FIRE DURING TEST 26



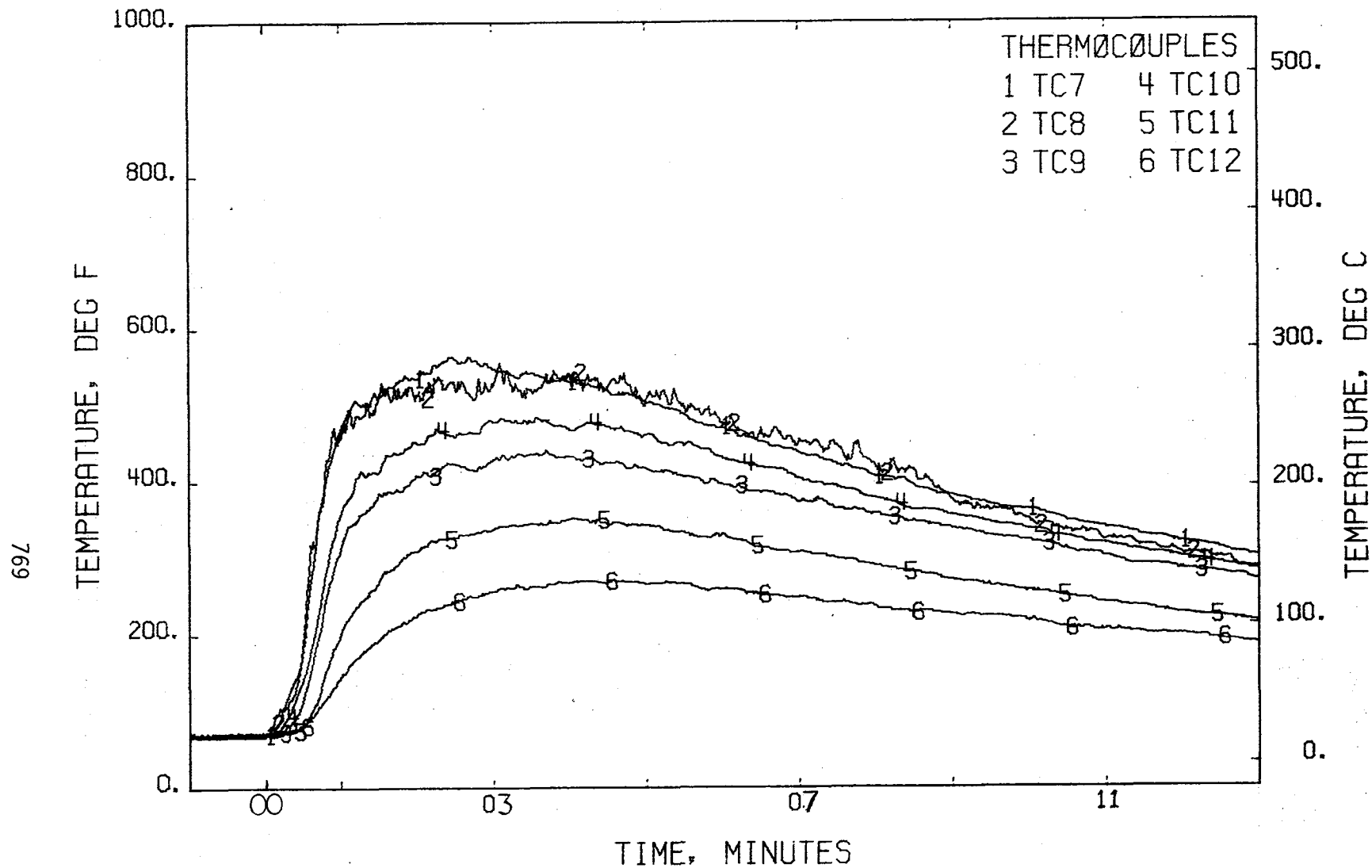


FIGURE 625 . - TEMPERATURES, T/C TREE 2  
TEST 26

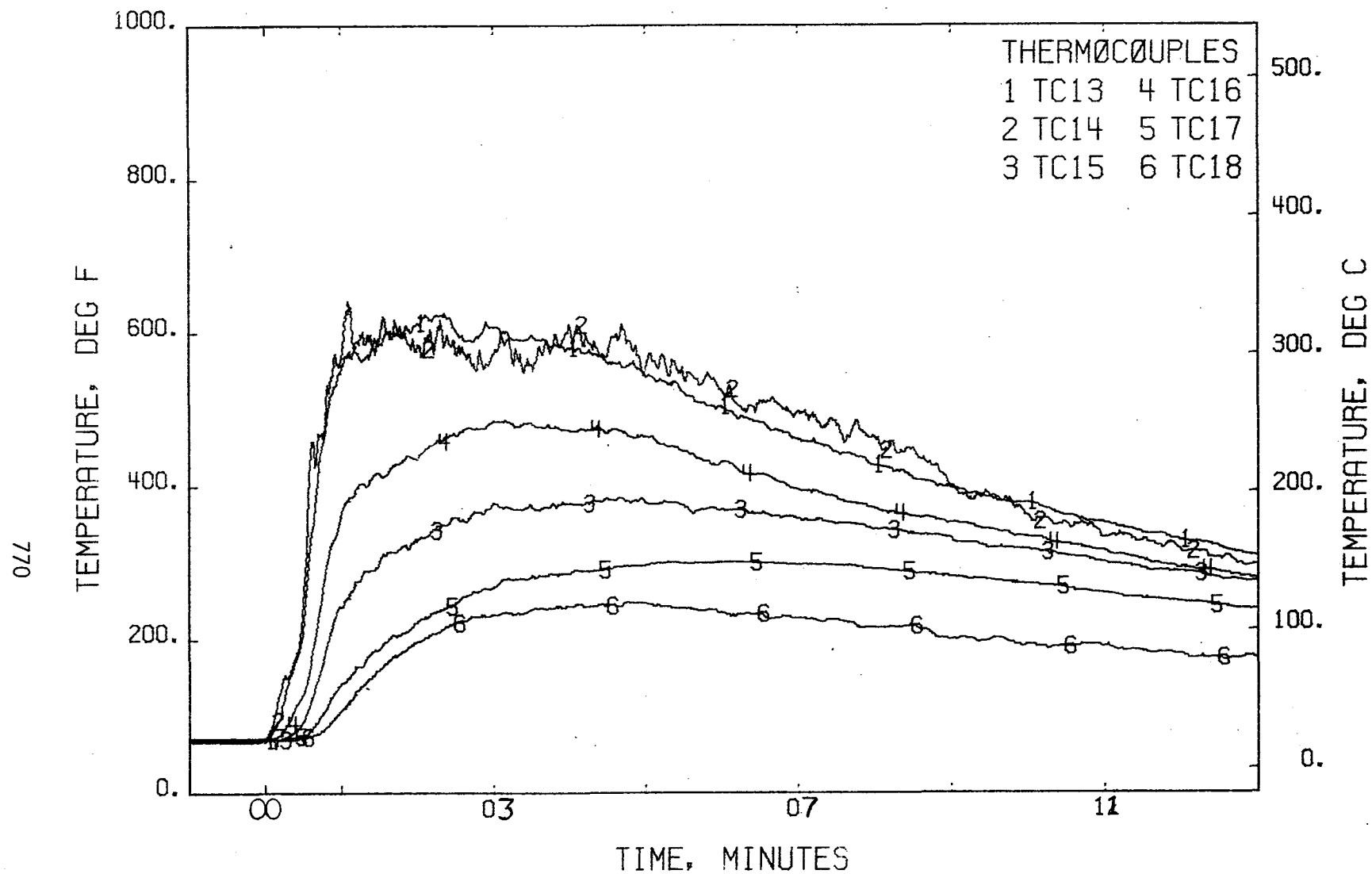


FIGURE 626 . - TEMPERATURES, T/C TREE 3  
TEST 26

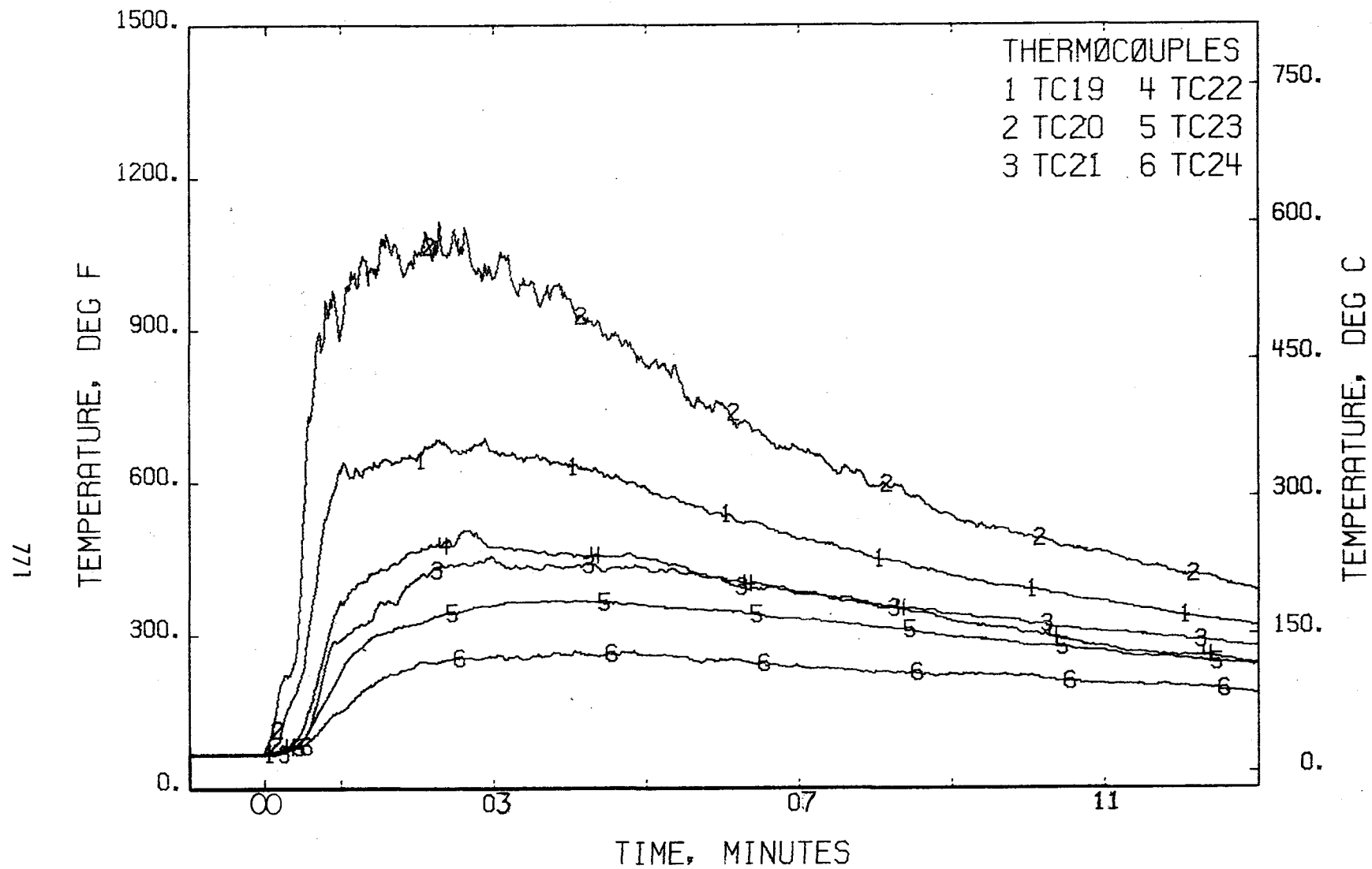


FIGURE 627 . - TEMPERATURES, T/C TREE 4  
TEST 26

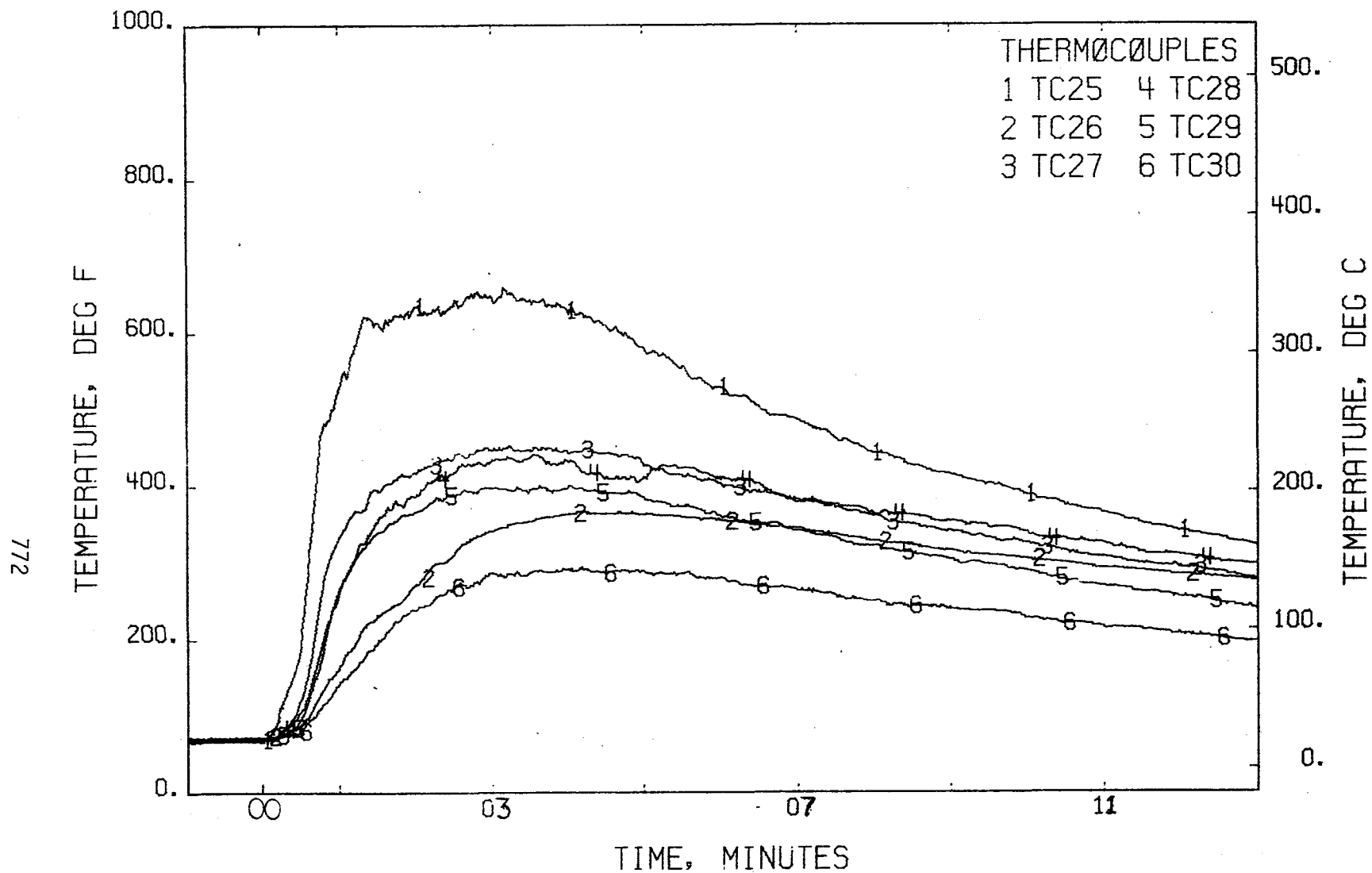


FIGURE 628 . - TEMPERATURES, T/C TREE 5  
TEST 26

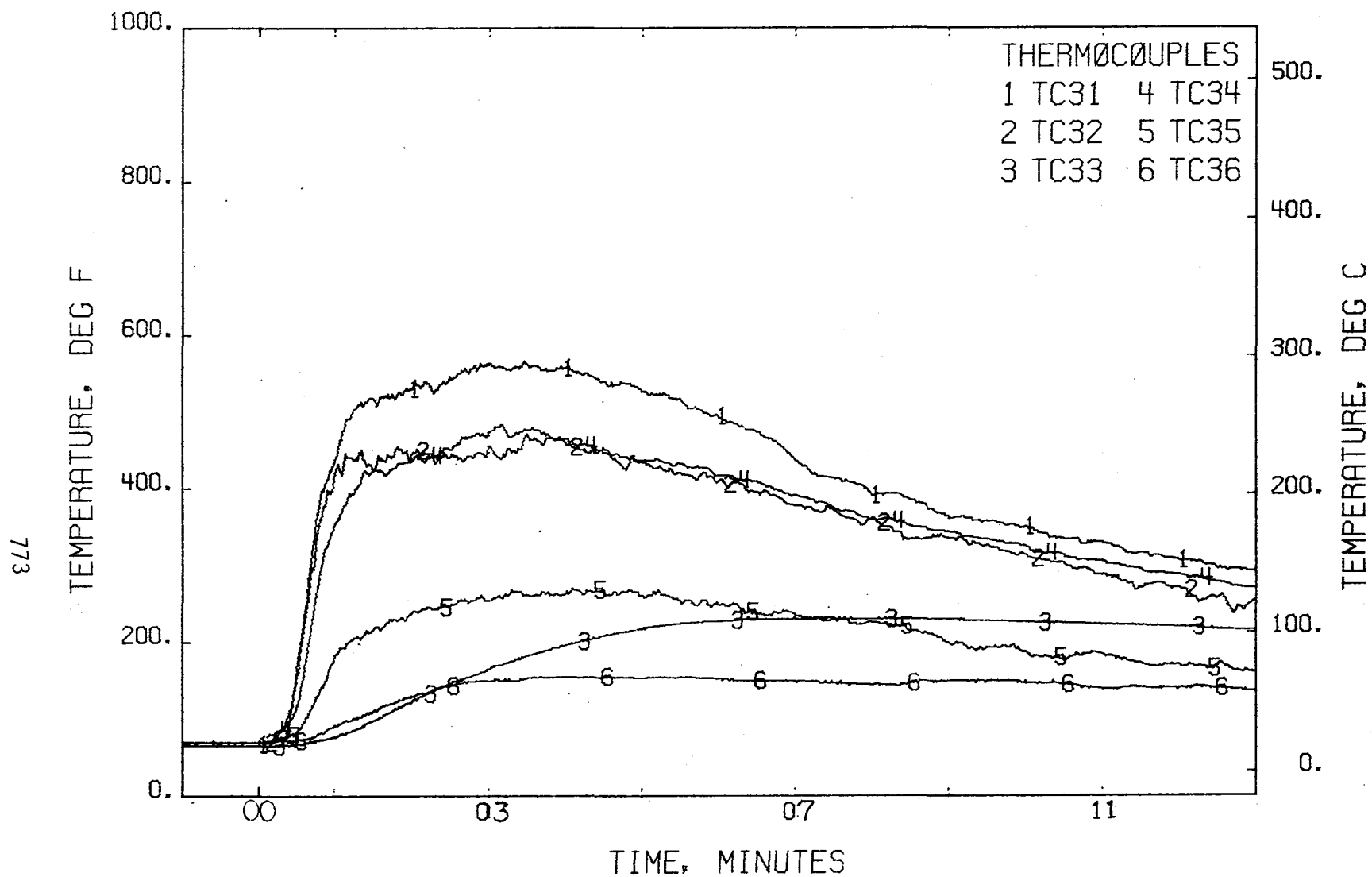


FIGURE 629 . - TEMPERATURES, T/C TREE 6  
TEST 26

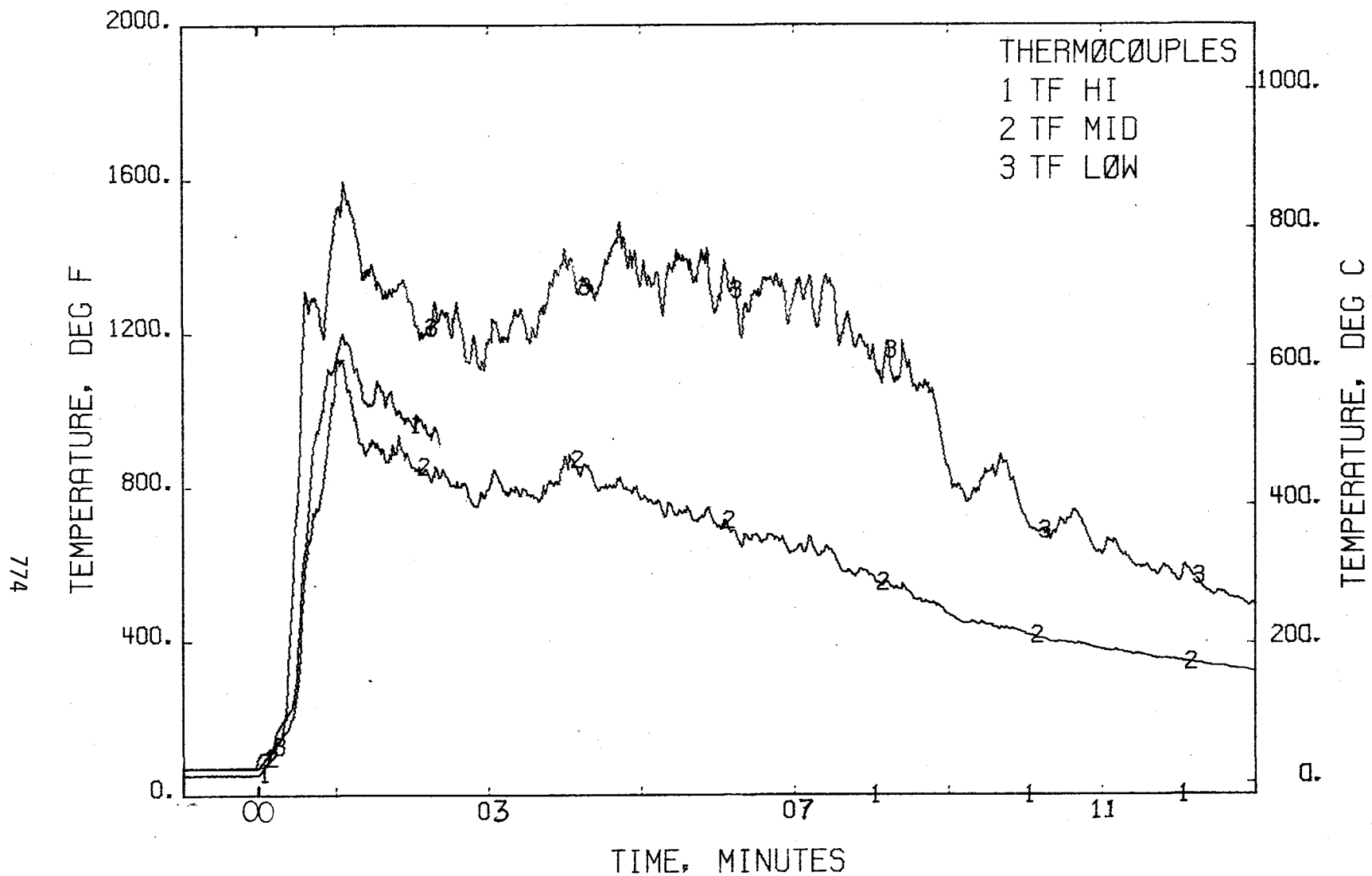


FIGURE 630 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 26

775

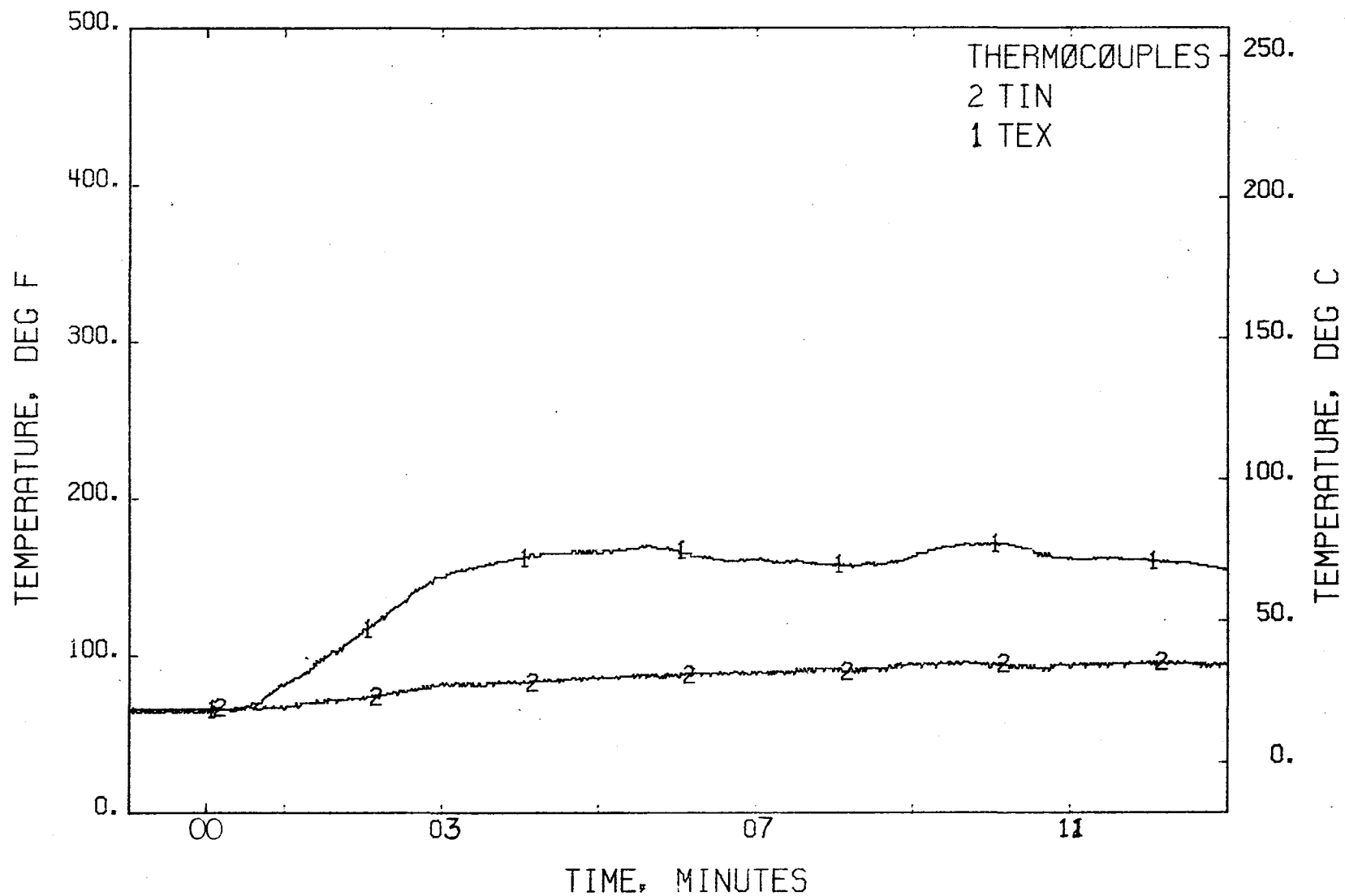


FIGURE 631 . - TEMPERATURES, INLET + EXIT  
TEST 26

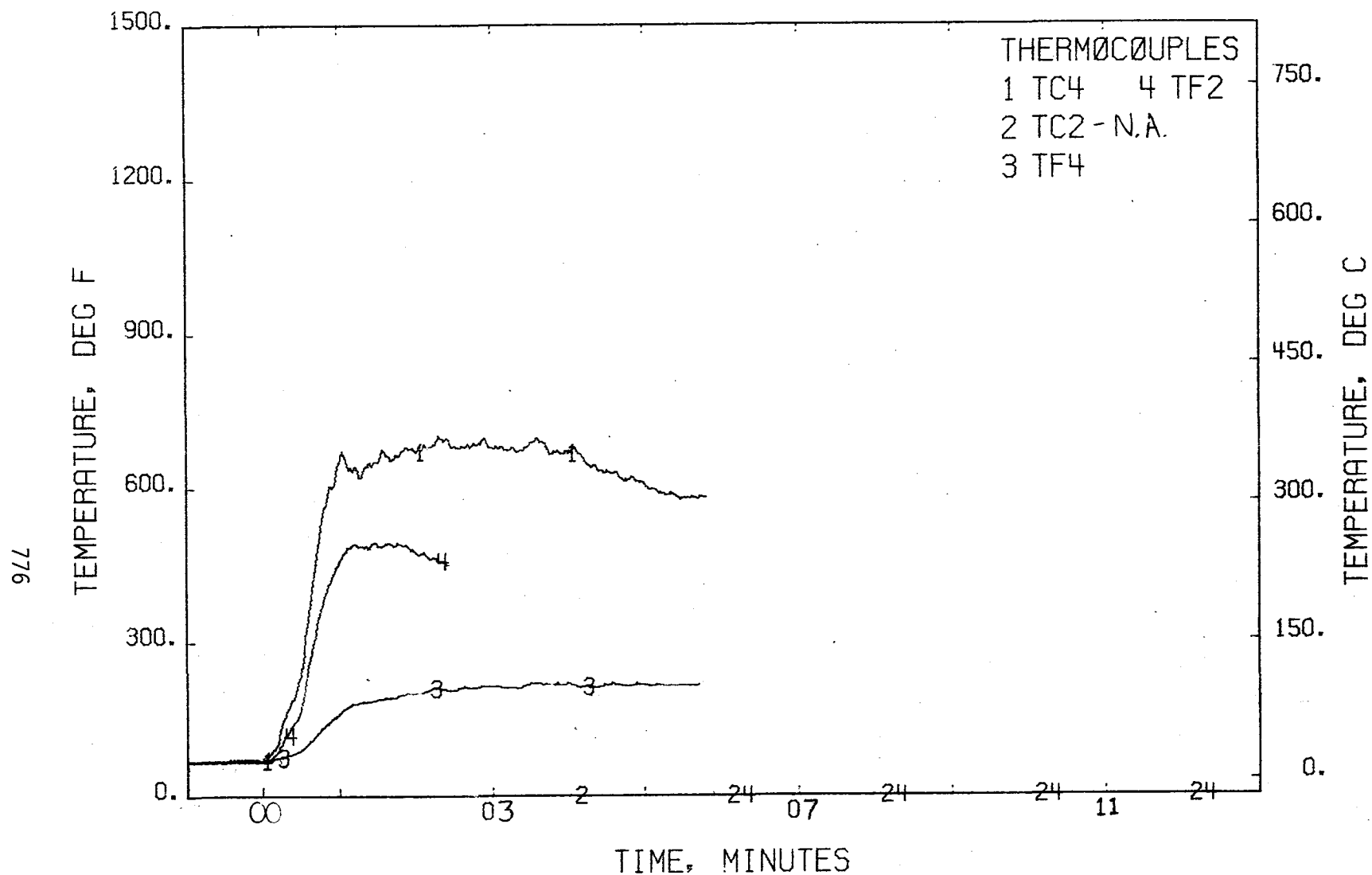


FIGURE 632 . - TEMPERATURES, CEILING + FLØØR (TREES 2+4)  
TEST 26



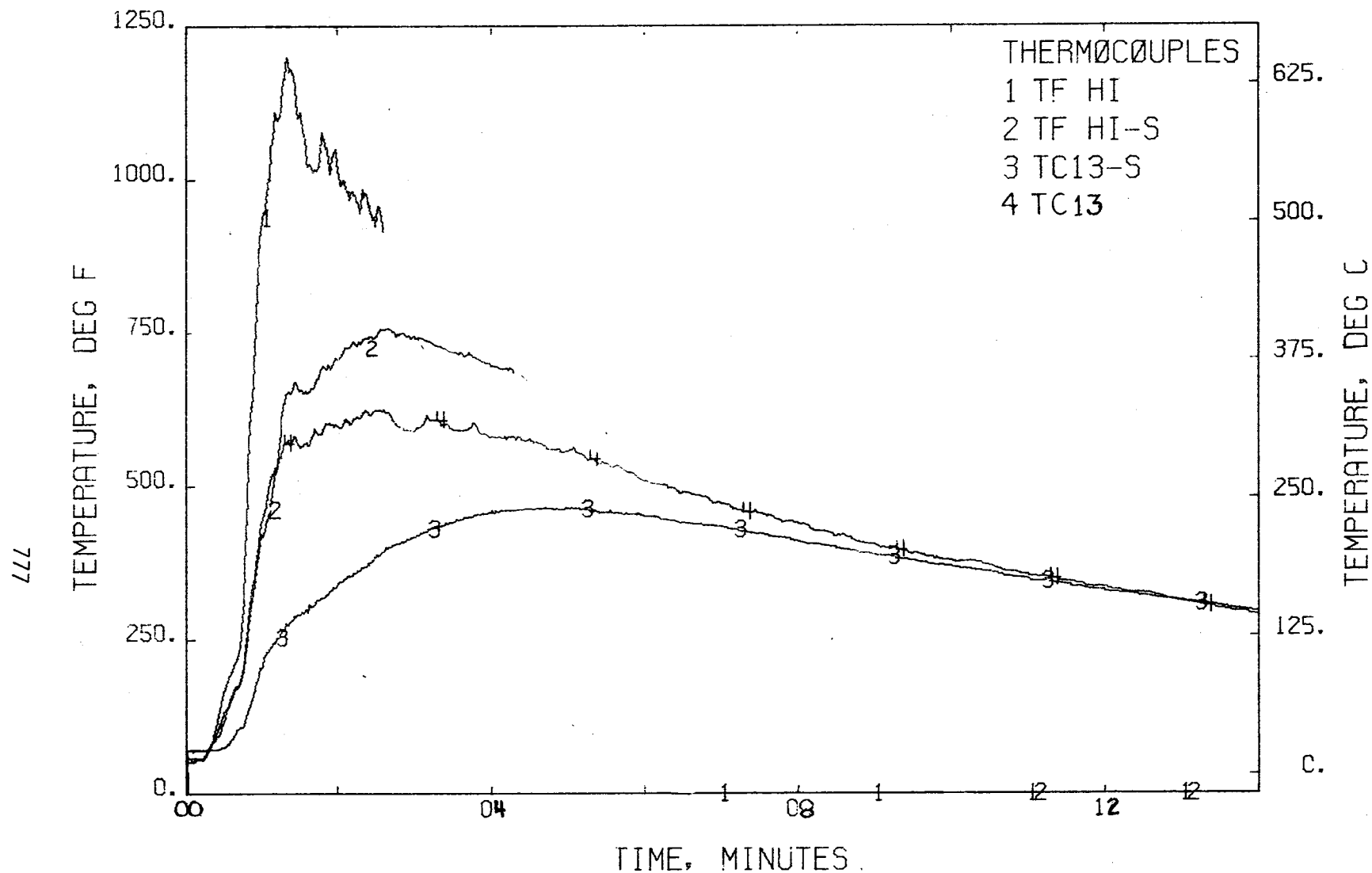


FIGURE 633 . - TEMPERATURES, SHIELDED VS UNSHIELDED T/C'S  
TEST 26

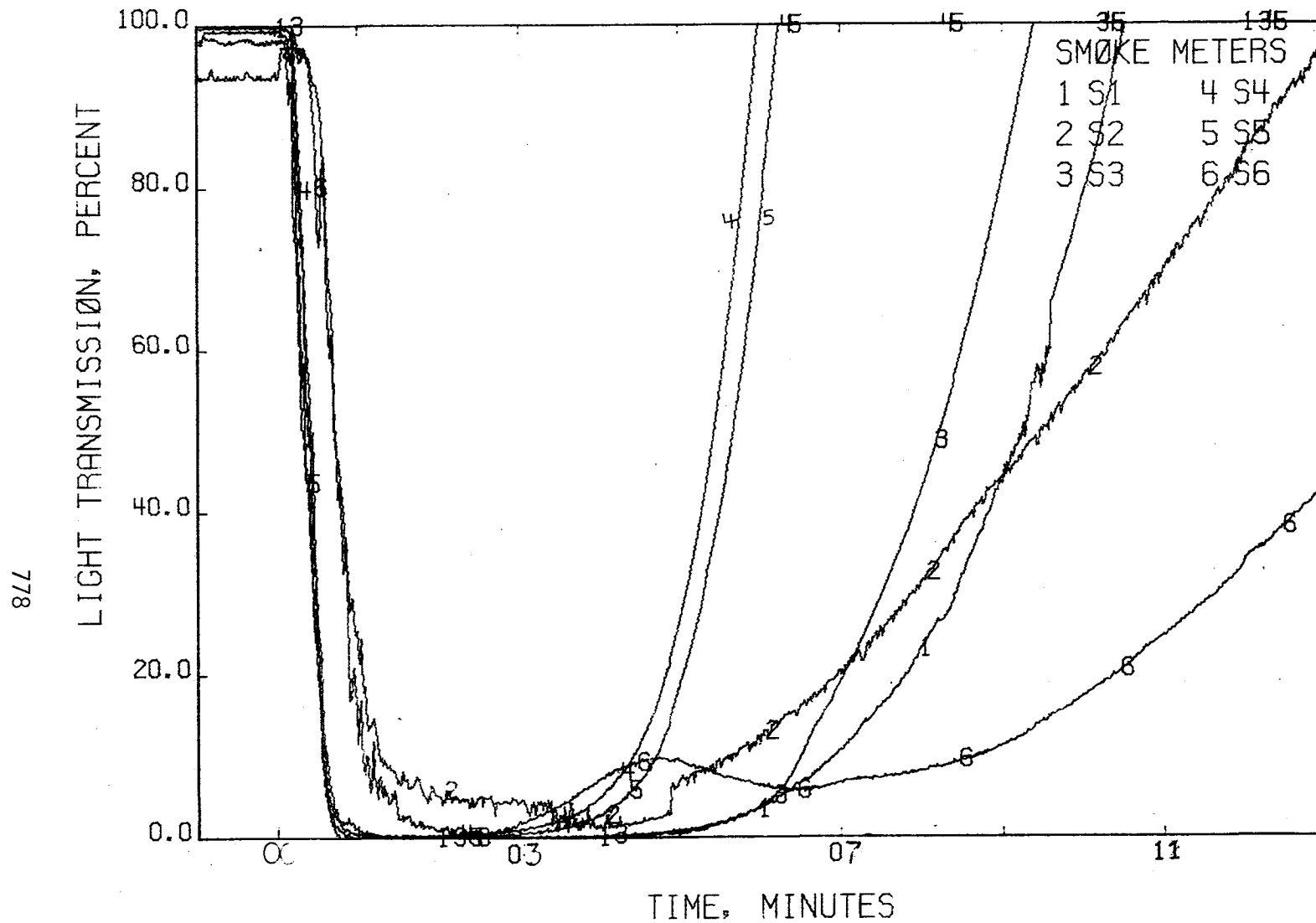


FIGURE 634 . - LIGHT TRANSMISSION  
TEST 26

779

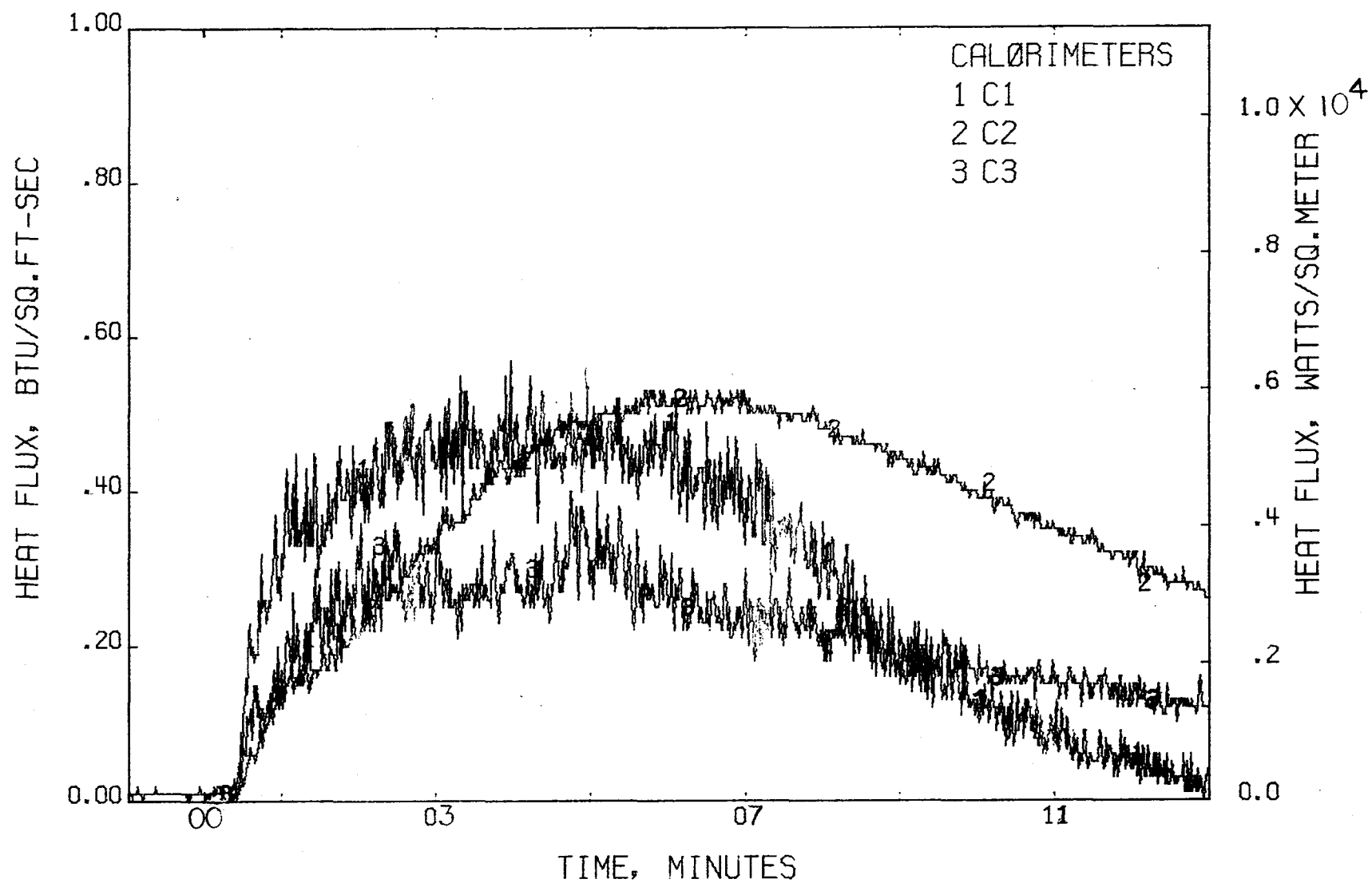


FIGURE 635 . - HEAT FLUX, AFT  
TEST 26

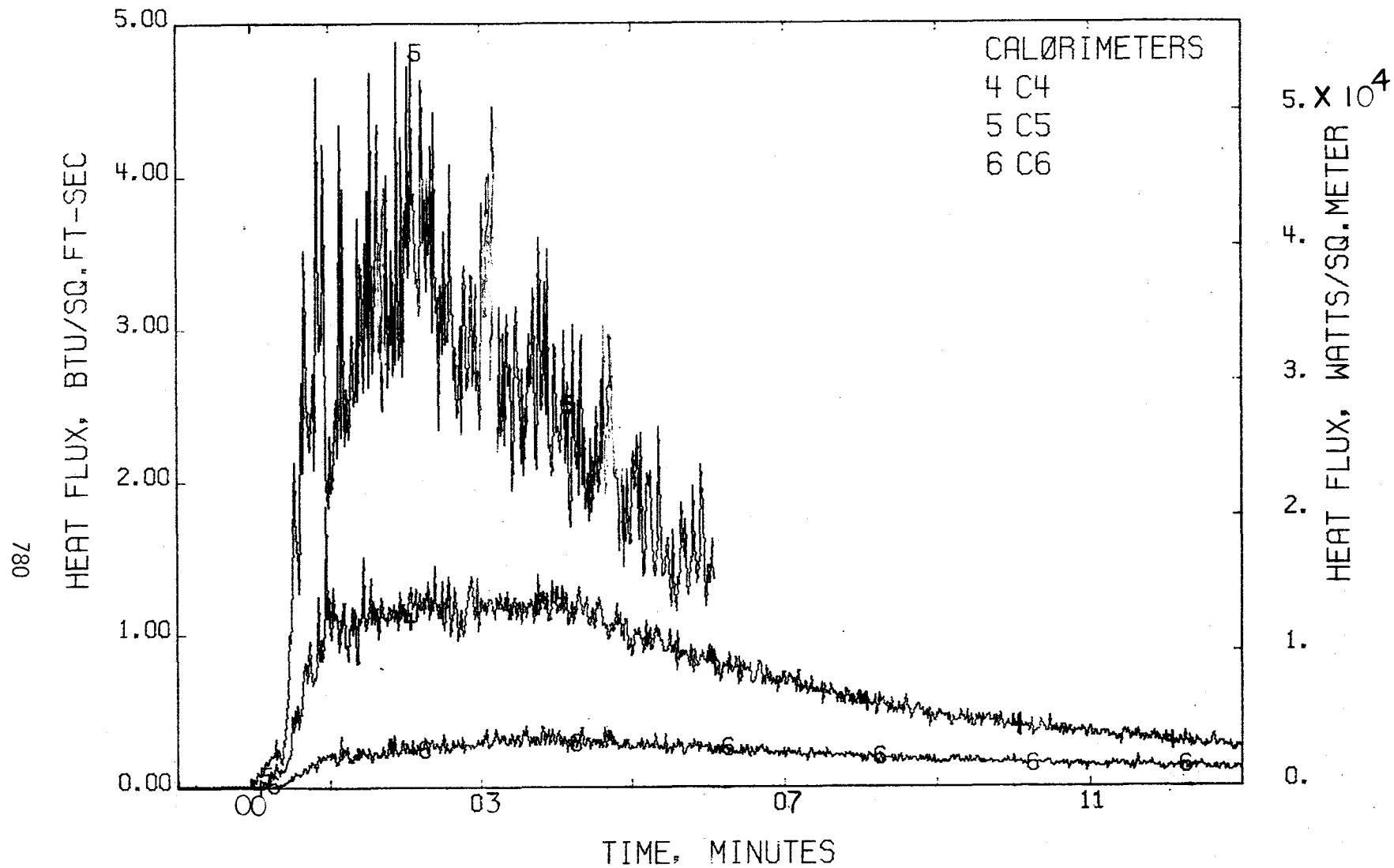
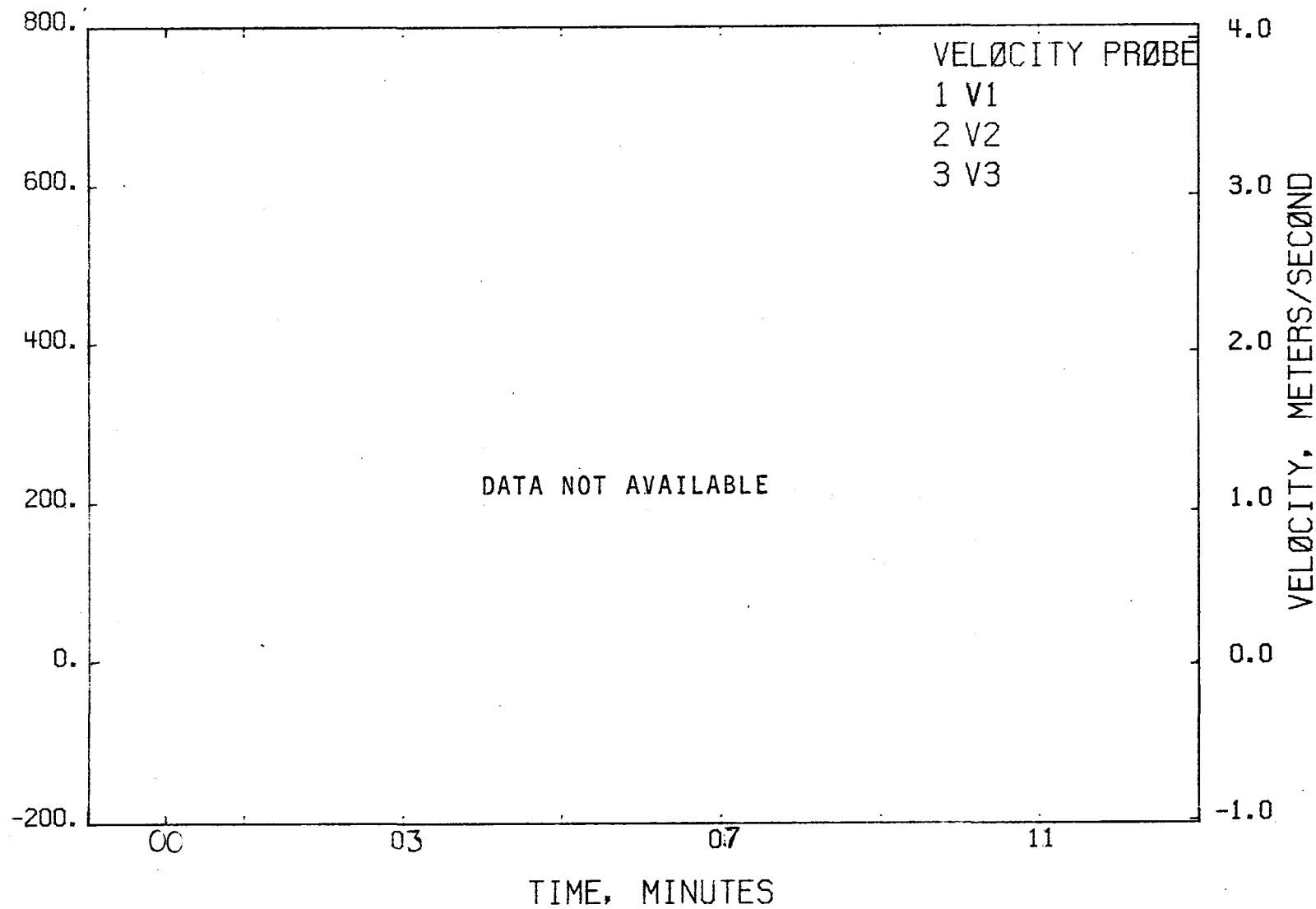


FIGURE 636 . - HEAT FLUX, MIDSECTION  
TEST 26

181

VELOCITY, FEET/MINUTE



AIR VELOCITY  
TEST 26

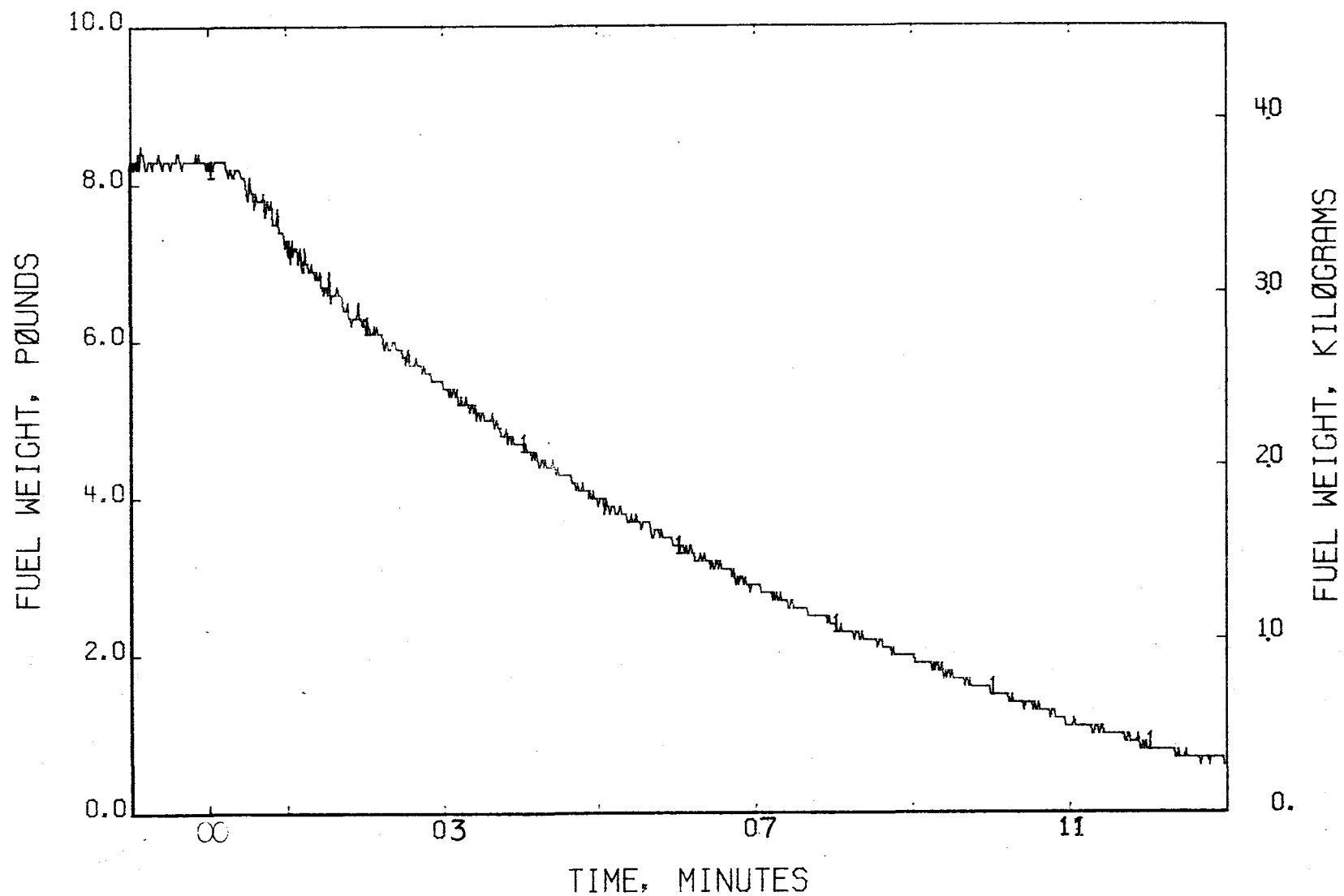


FIGURE 637 . - FUEL WEIGHT LOSS  
TEST 26

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 3 PPM

HYDROGEN FLUORIDE - < 3 PPM

HYDROGEN CHLORIDE - < 6 PPM

FIGURE 638 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 26

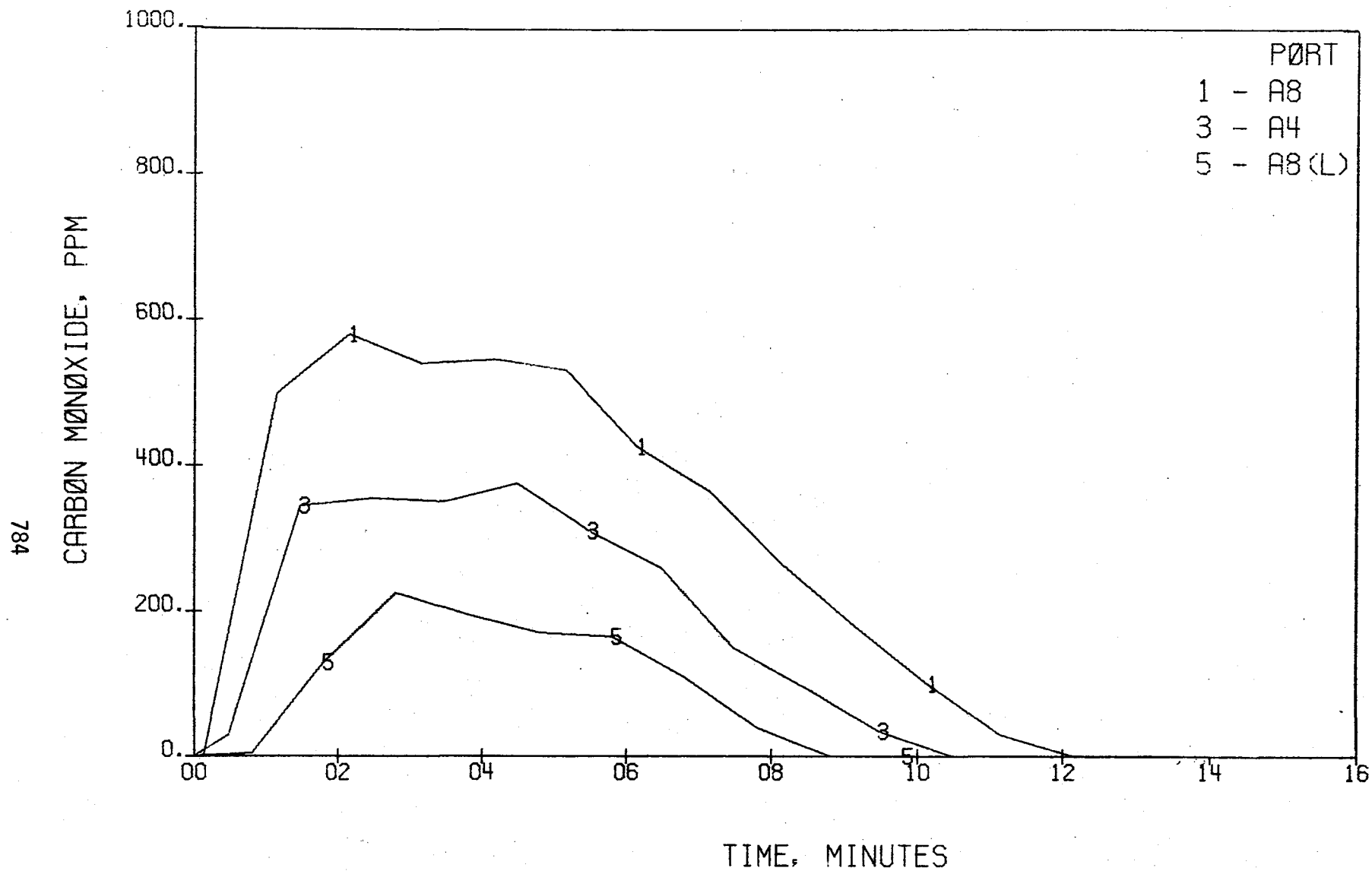


FIGURE 639 . - CARBON MONOXIDE CONCENTRATIONS , AFT  
TEST 26



785

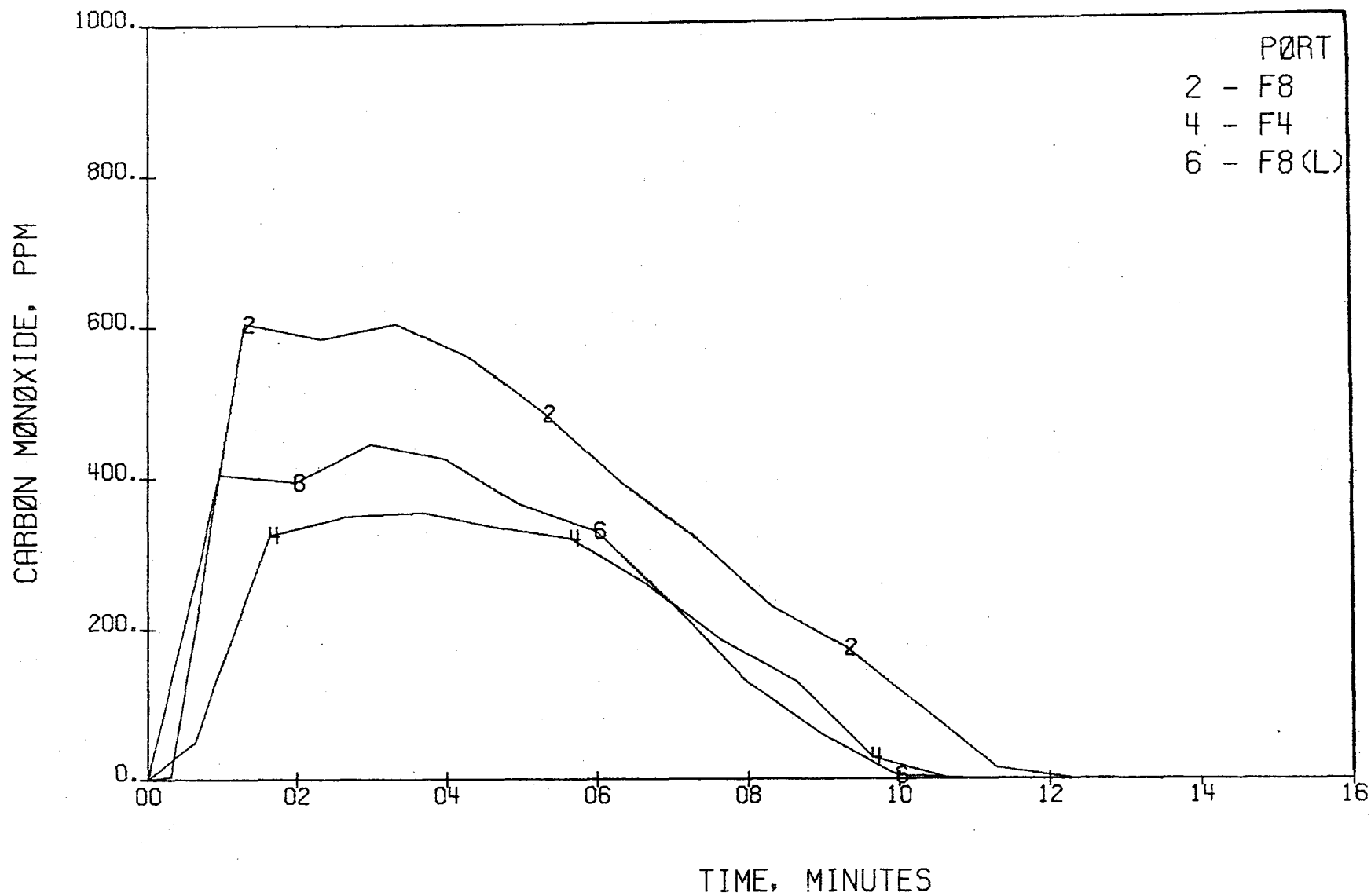


FIGURE : 640 . - CARBON MONOXIDE CONCENTRATIONS , FØRE  
TEST 26

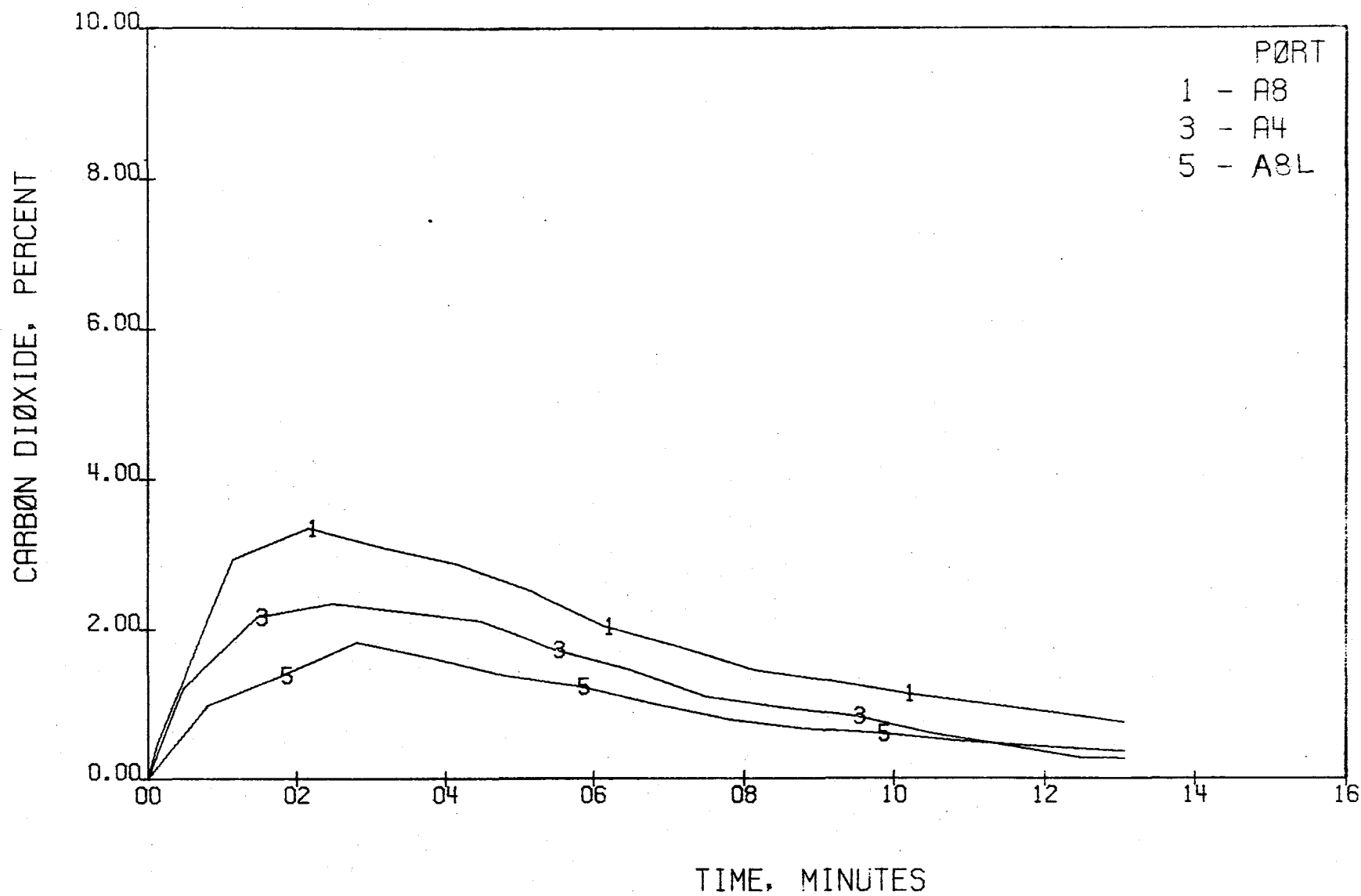


FIGURE 641 . - CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 26

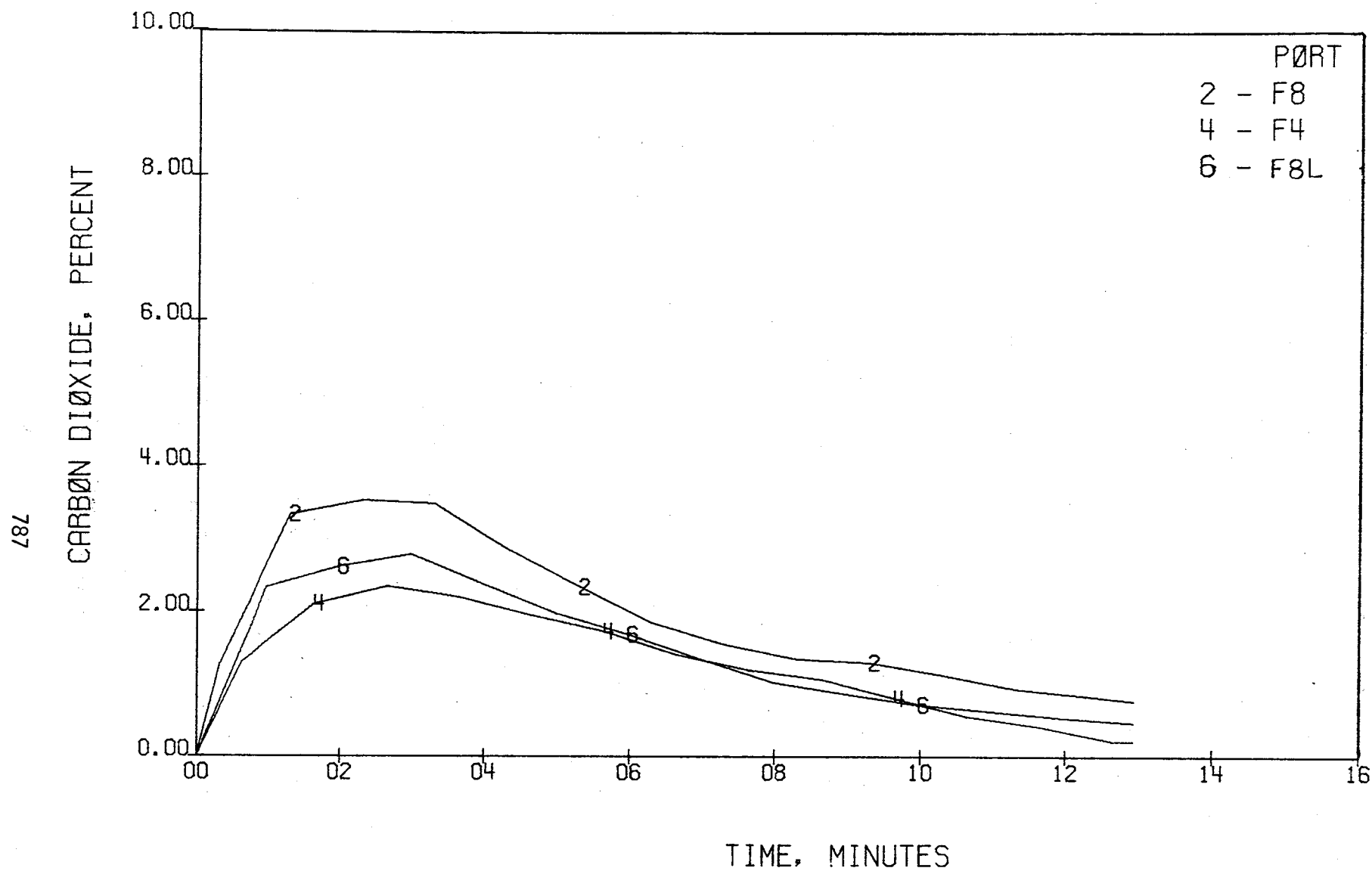


FIGURE 642 - CARBON DIOXIDE CONCENTRATIONS, FØRE TEST 26

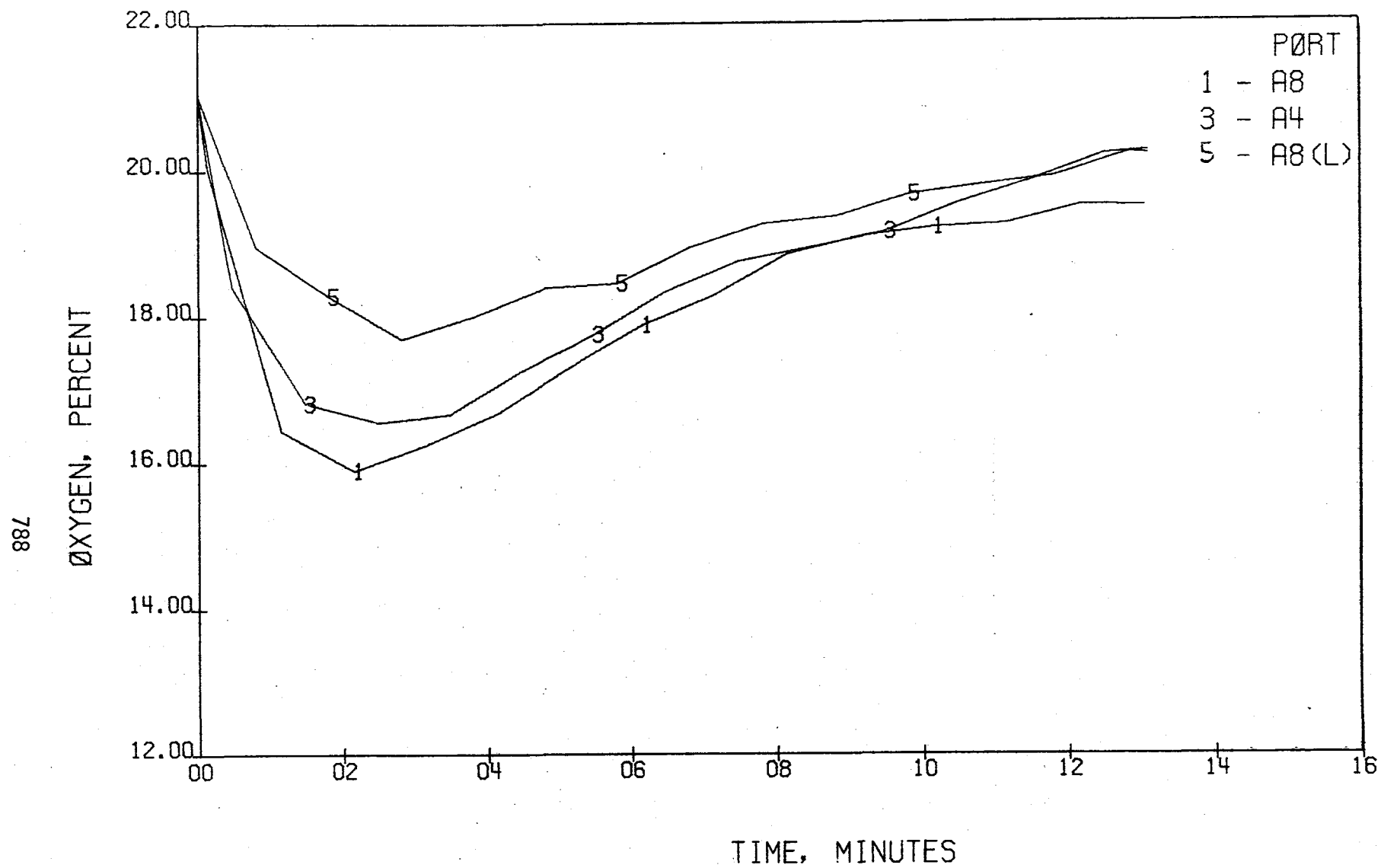


FIGURE 643 . - OXYGEN CONCENTRATIONS , AFT  
TEST 26

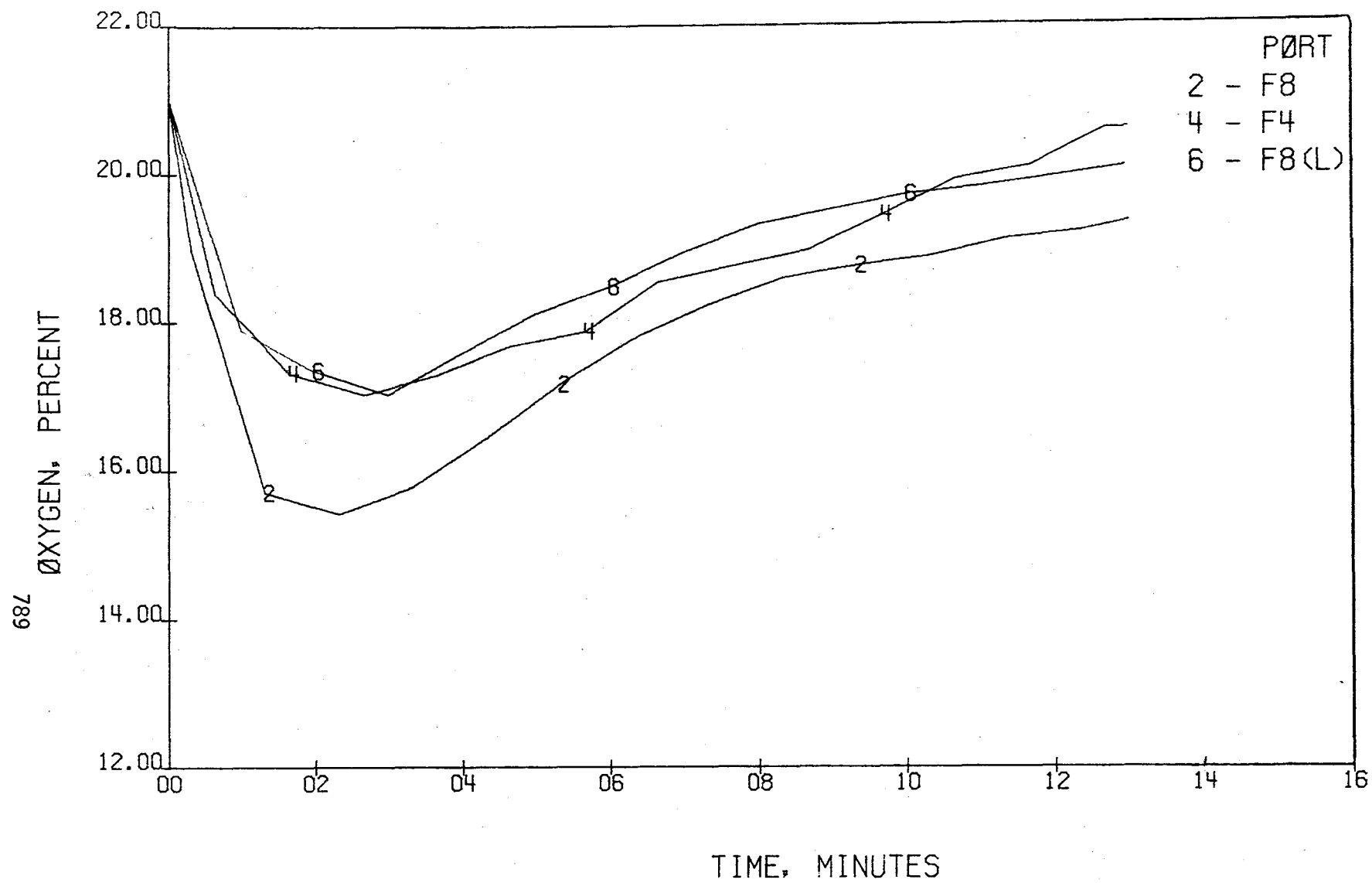


FIGURE 644 . - OXYGEN CONCENTRATIONS, FØRE  
TEST 26

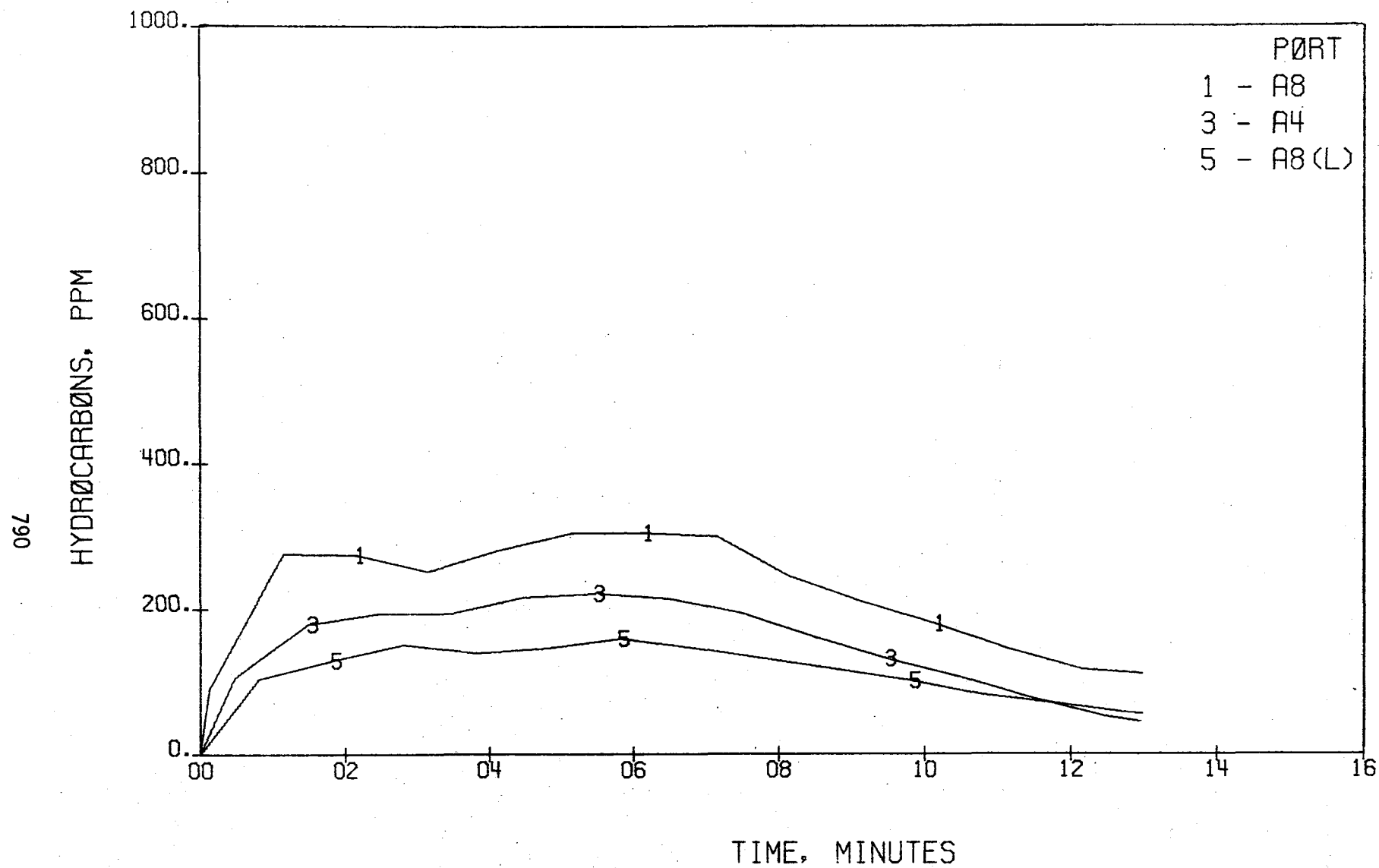


FIGURE 645 . - HYDROCARBONS CONCENTRATIONS , AFT  
TEST 26

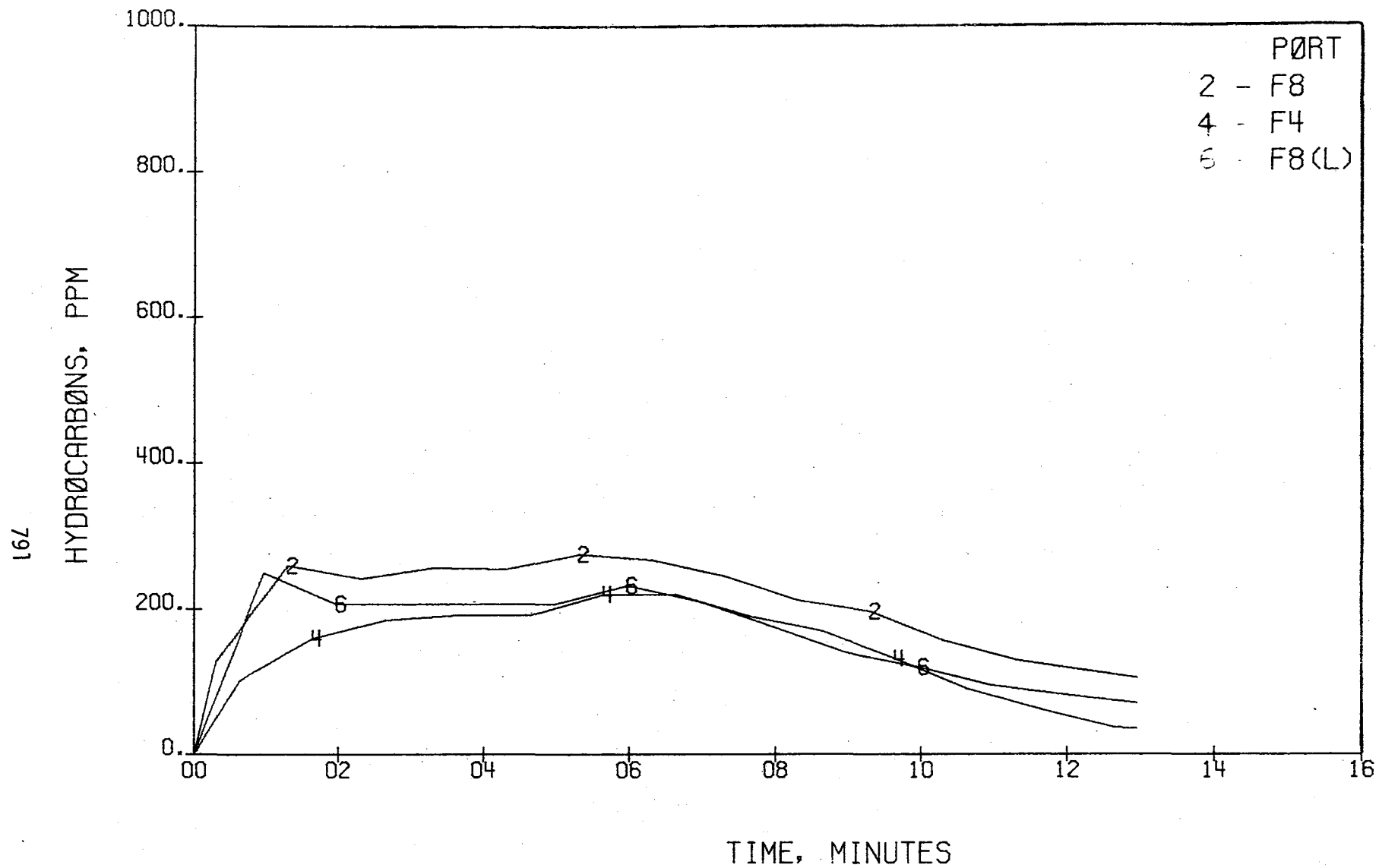


FIGURE 646 .- HYDROCARBONS CONCENTRATIONS , FØRE  
TEST 26





TEST 27  

---

FUEL ONLY

TEST 27  
FUEL ONLY

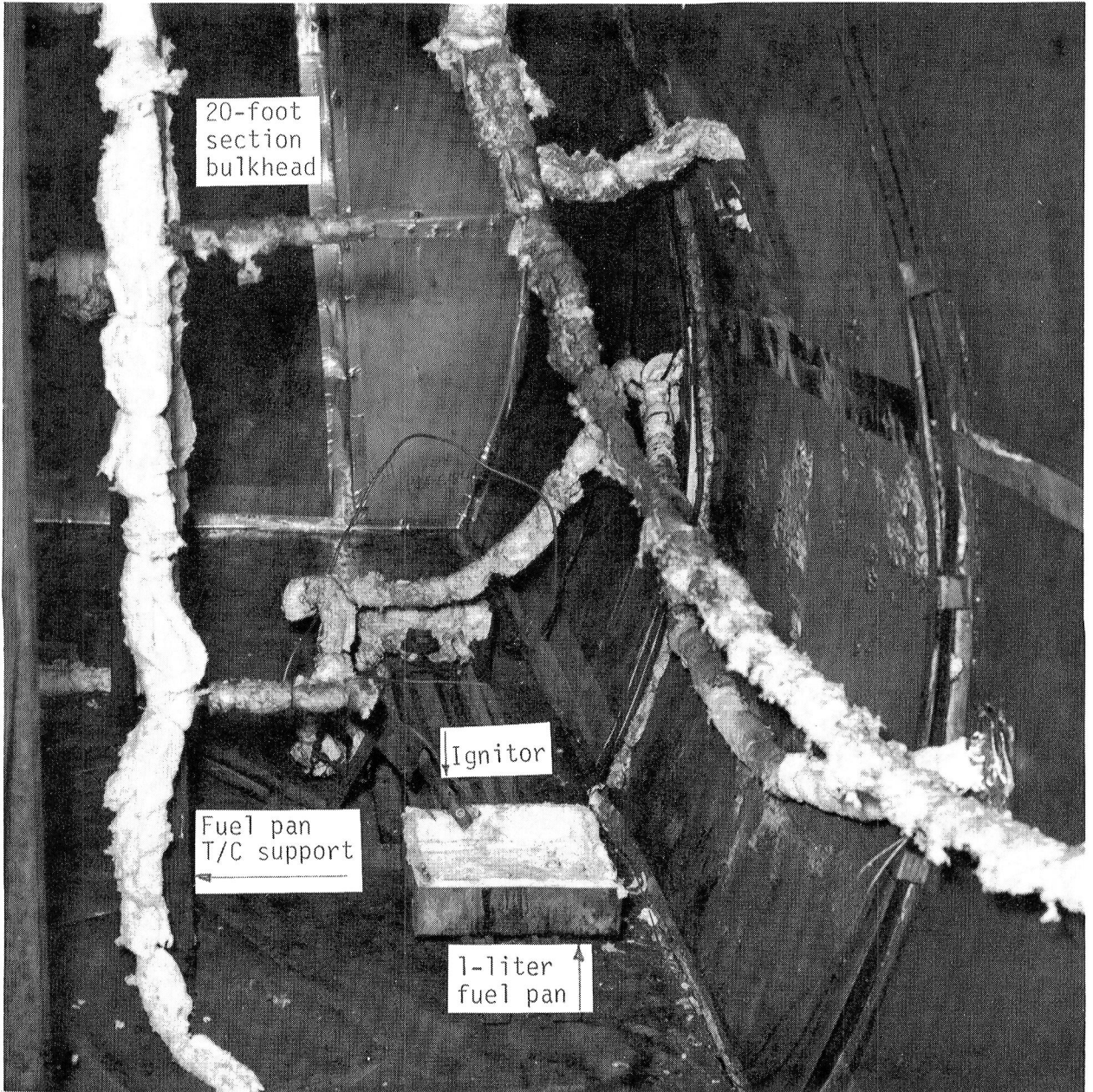


FIGURE 647 . - PRE-TEST CONFIGURATION, TEST 27

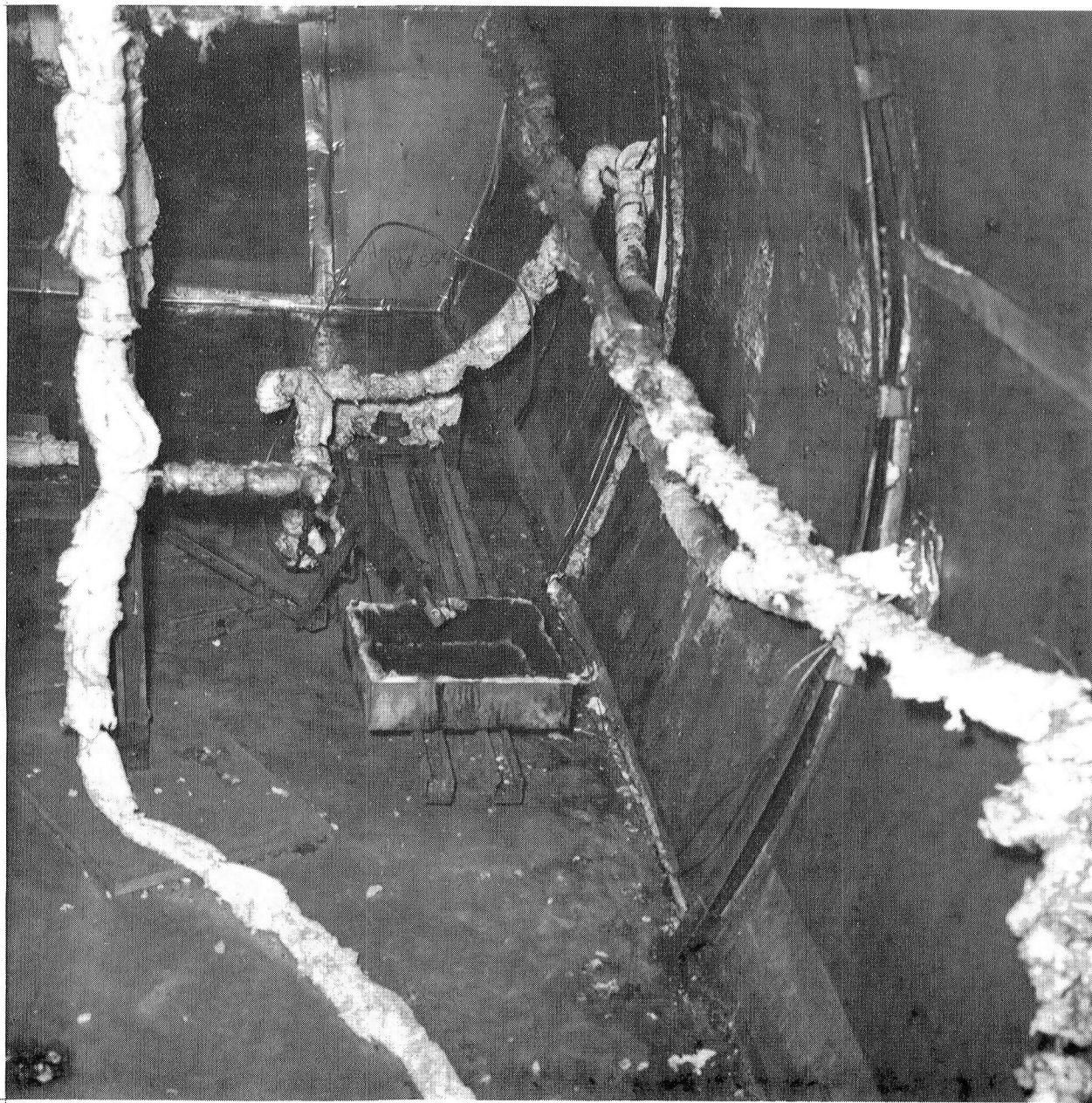


FIGURE 648. - POST-TEST CONFIGURATION, TEST 27



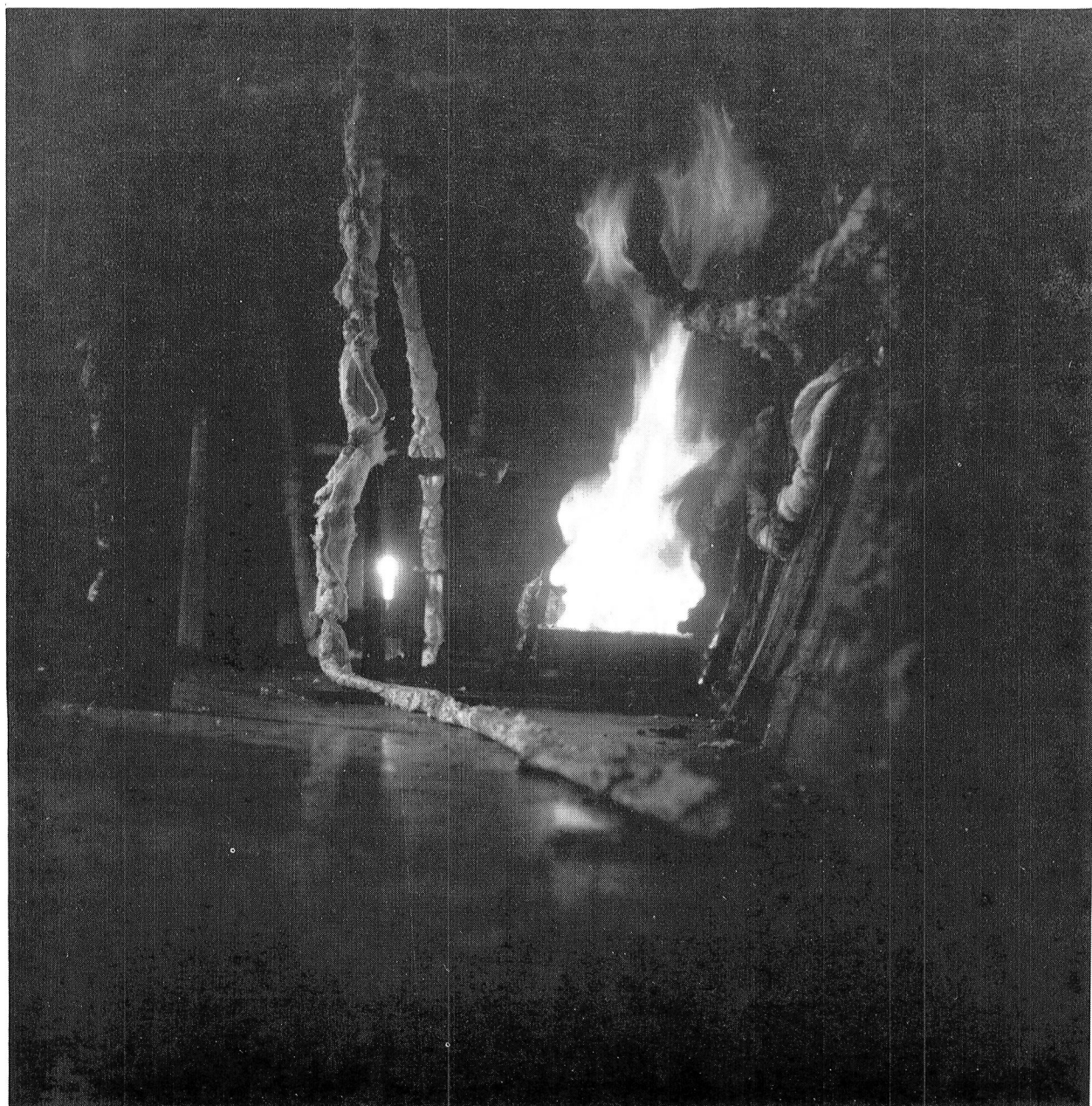


FIGURE 649 . - FIRE DURING TEST 27

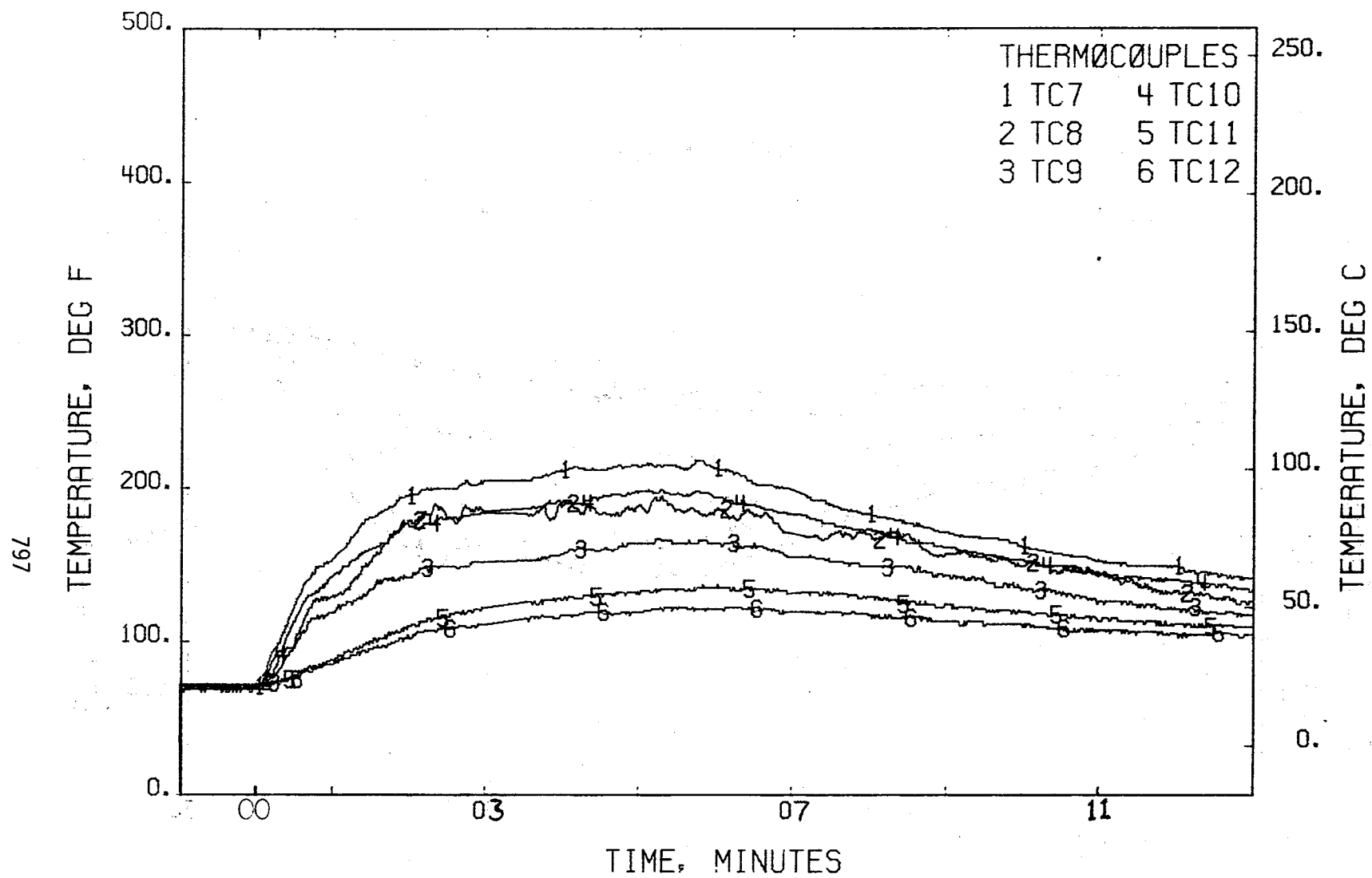


FIGURE 650 . - TEMPERATURES, T/C TREE 2  
TEST 27

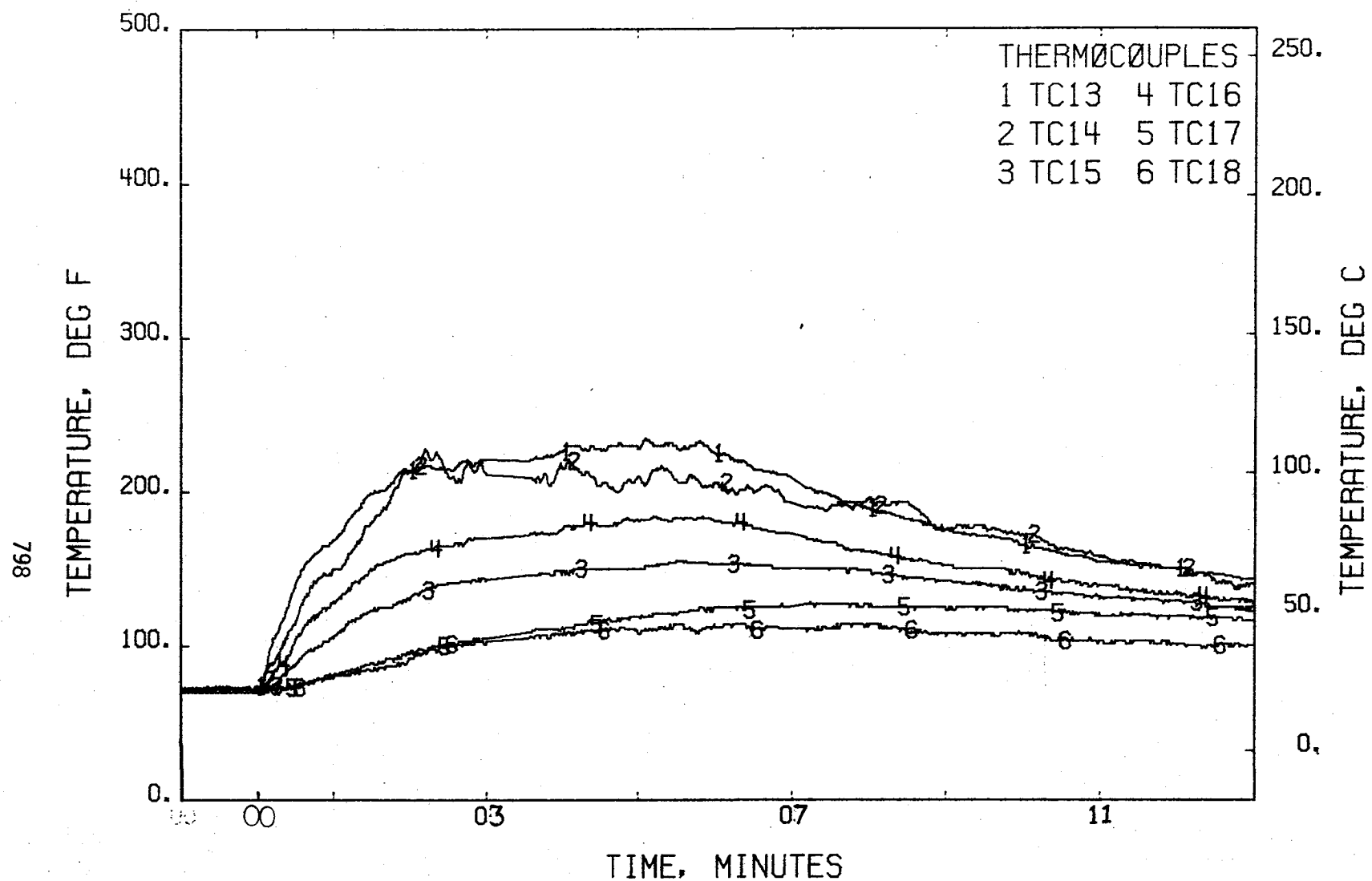


FIGURE 651 . - TEMPERATURES, T/C TREE 3  
TEST 27

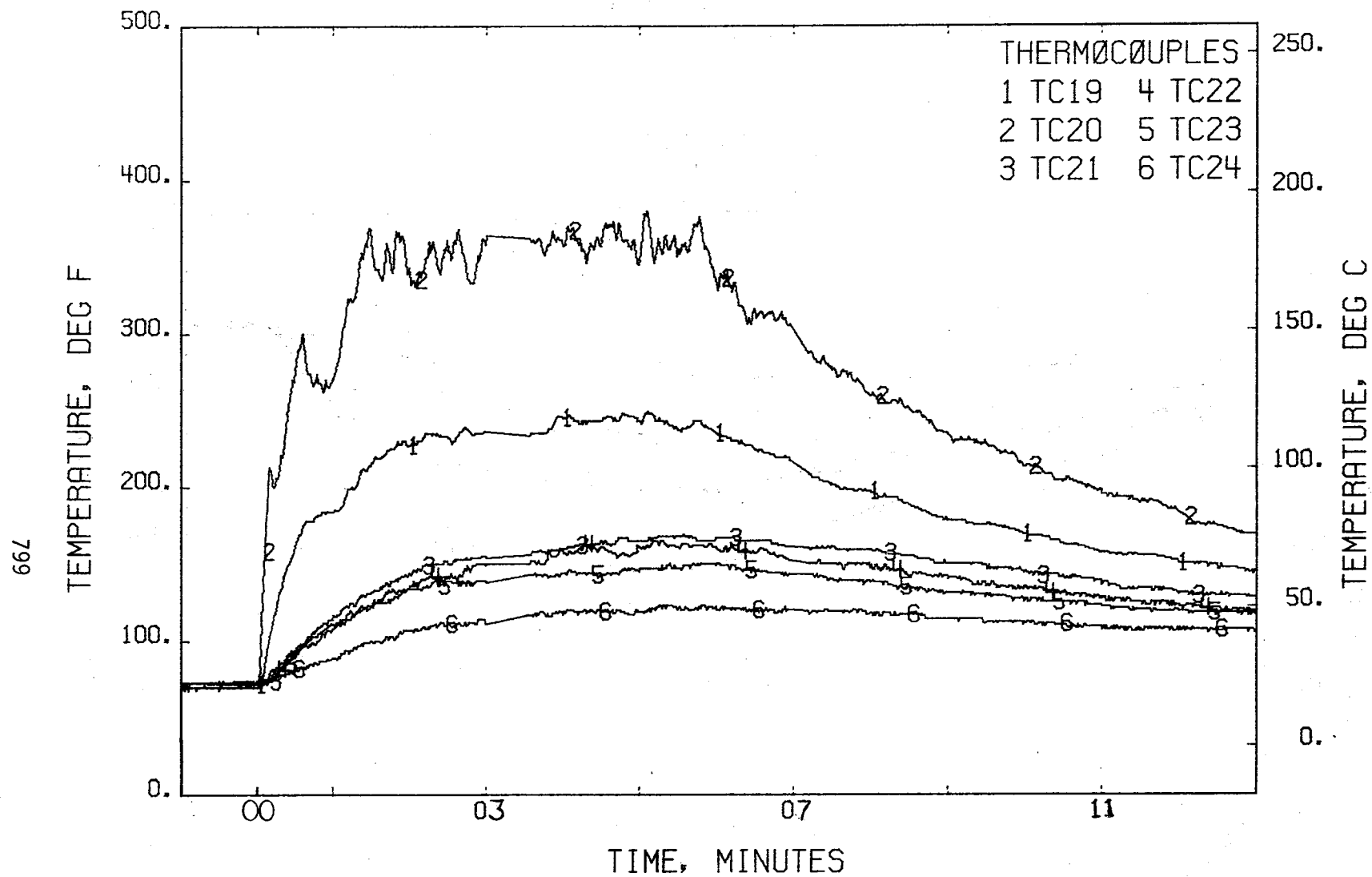


FIGURE 652 . - TEMPERATURES, T/C TREE 4  
TEST 27

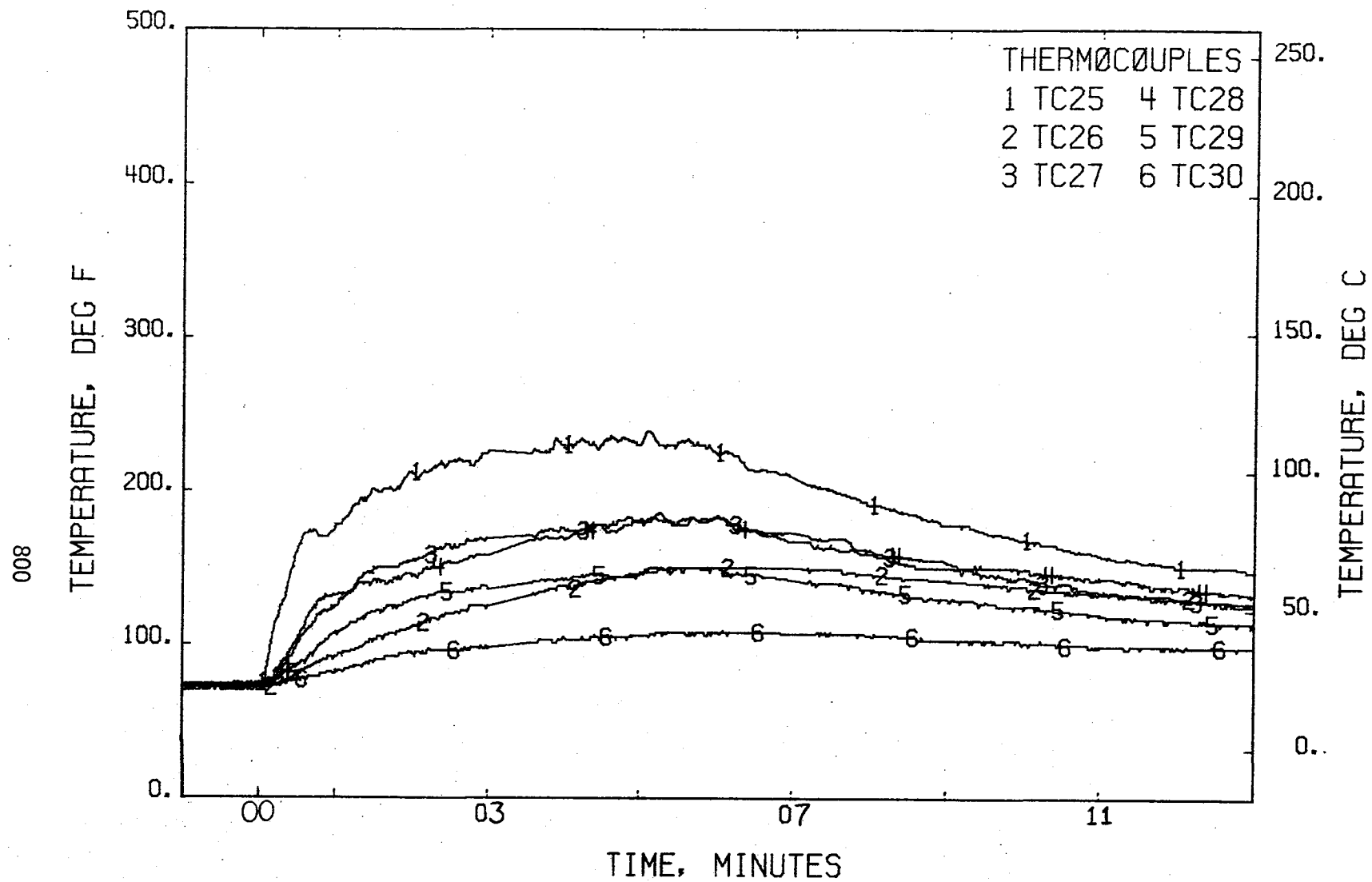


FIGURE 653 . - TEMPERATURES, T/C TREE 5  
TEST 27



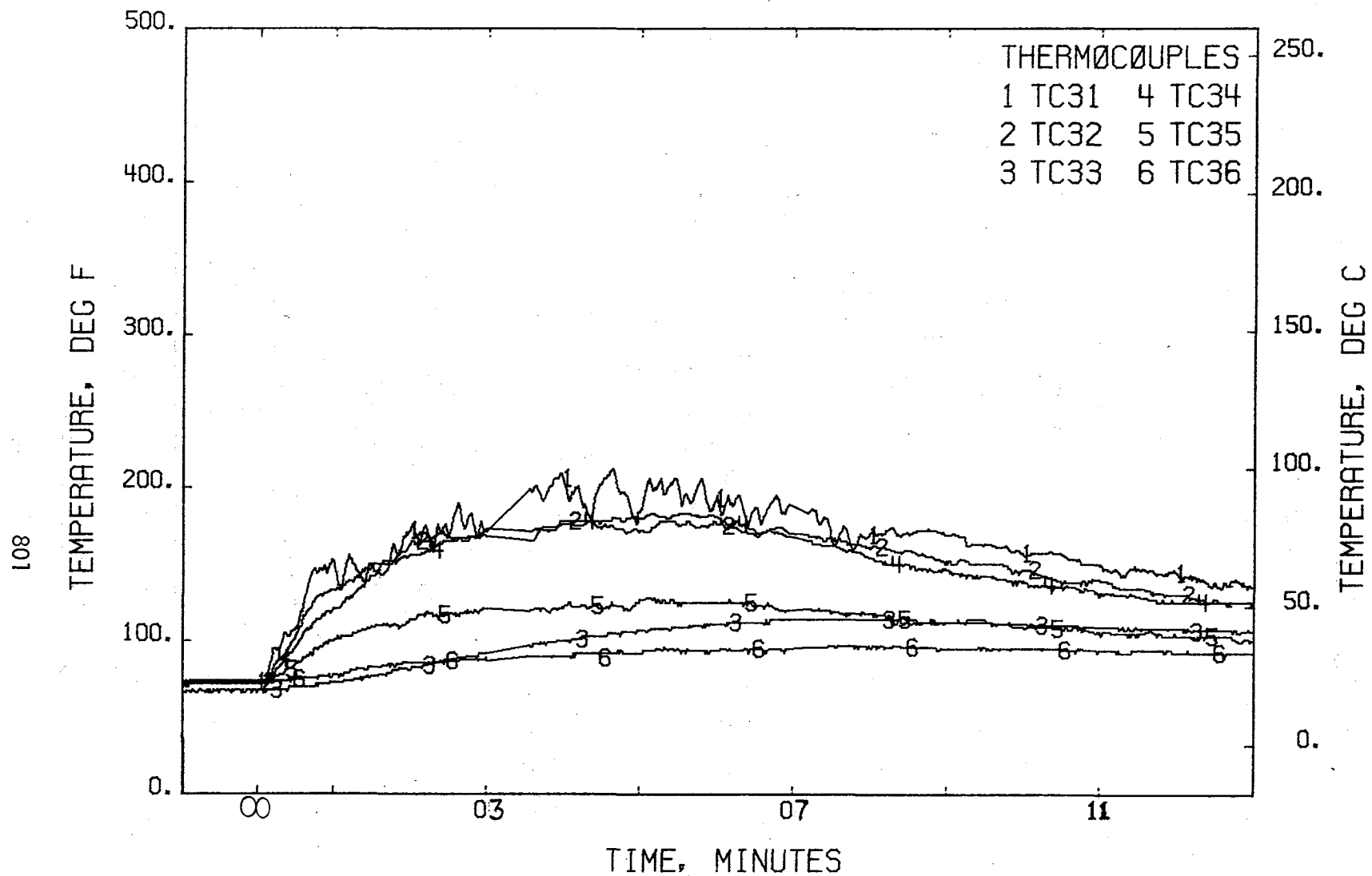


FIGURE 654 . - TEMPERATURES, T/C TREE 6  
TEST 27

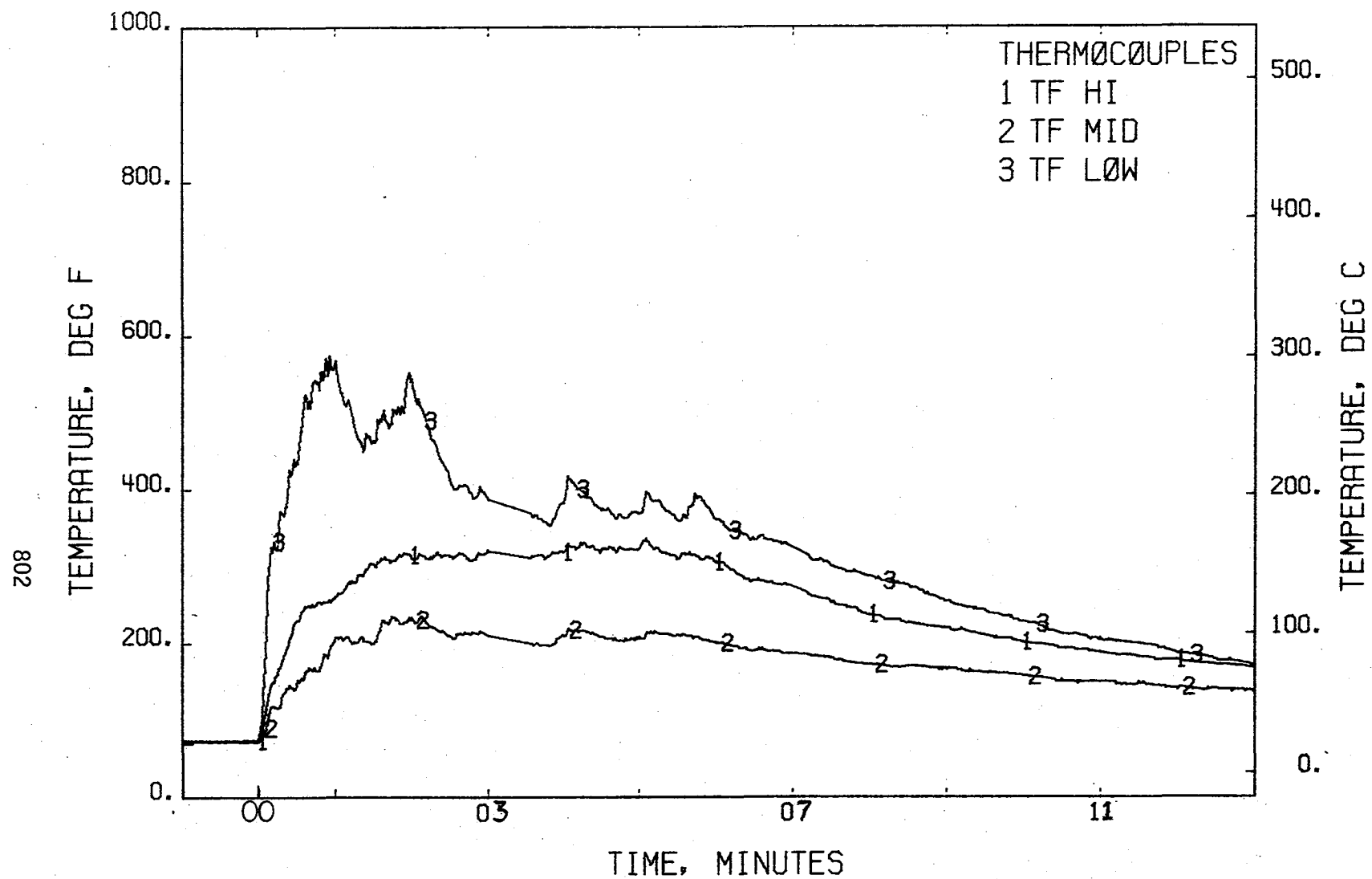


FIGURE 655 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 27

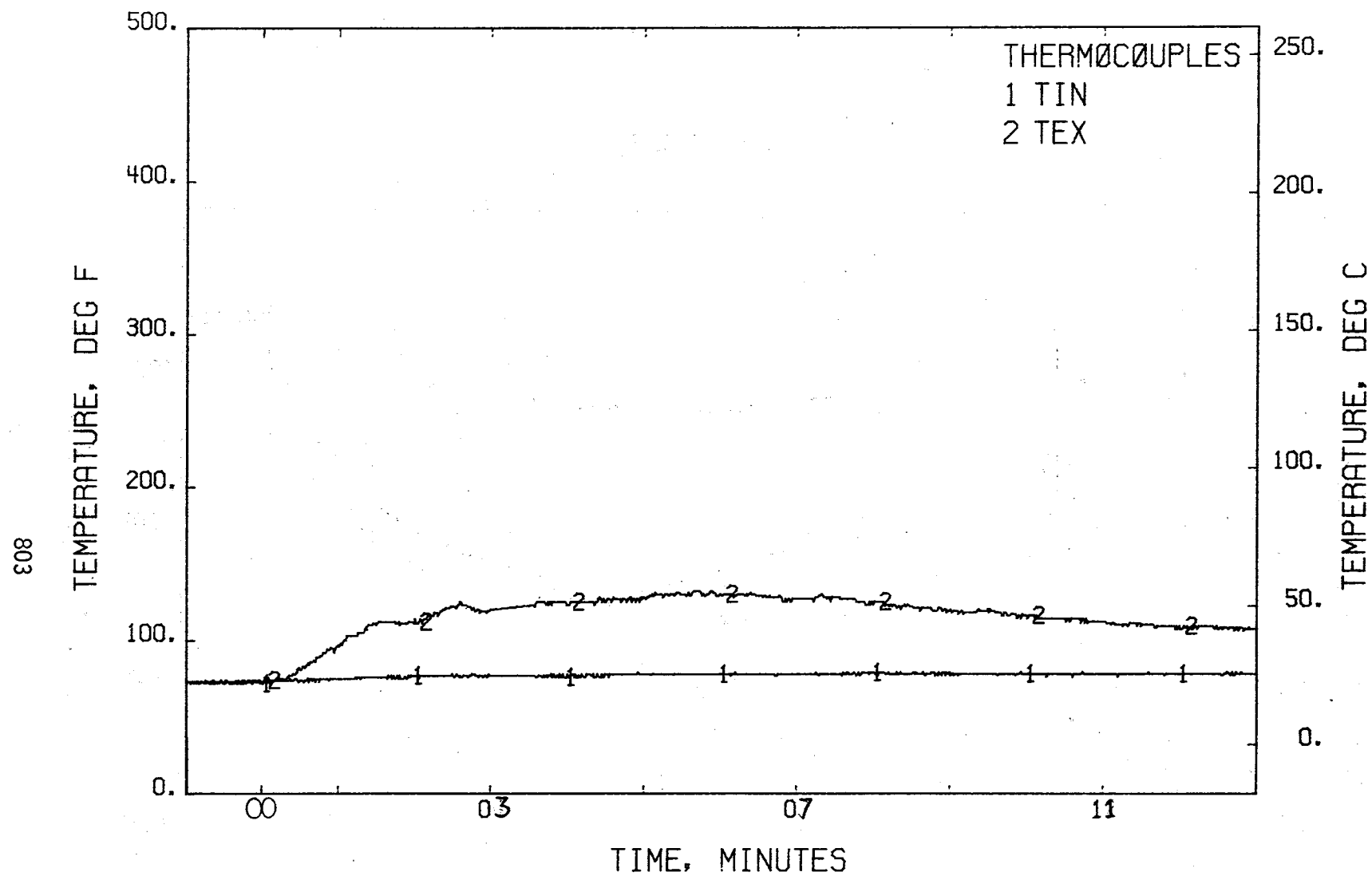


FIGURE 656 . - TEMPERATURES, INLET + EXIT  
TEST 27

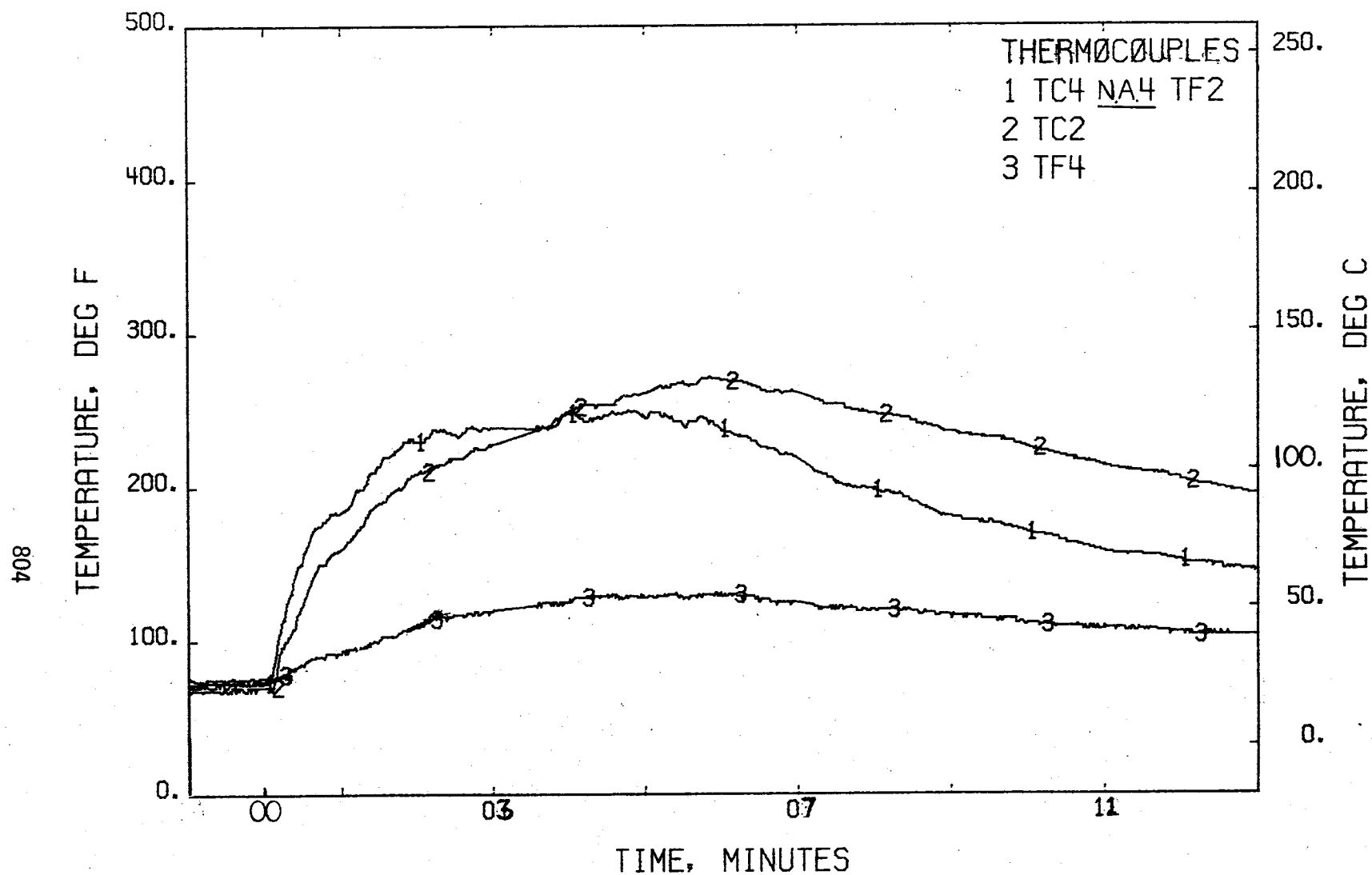


FIGURE 657 . - TEMPERATURES, CEILING + FLOOR (TREES 2+4)  
TEST 27

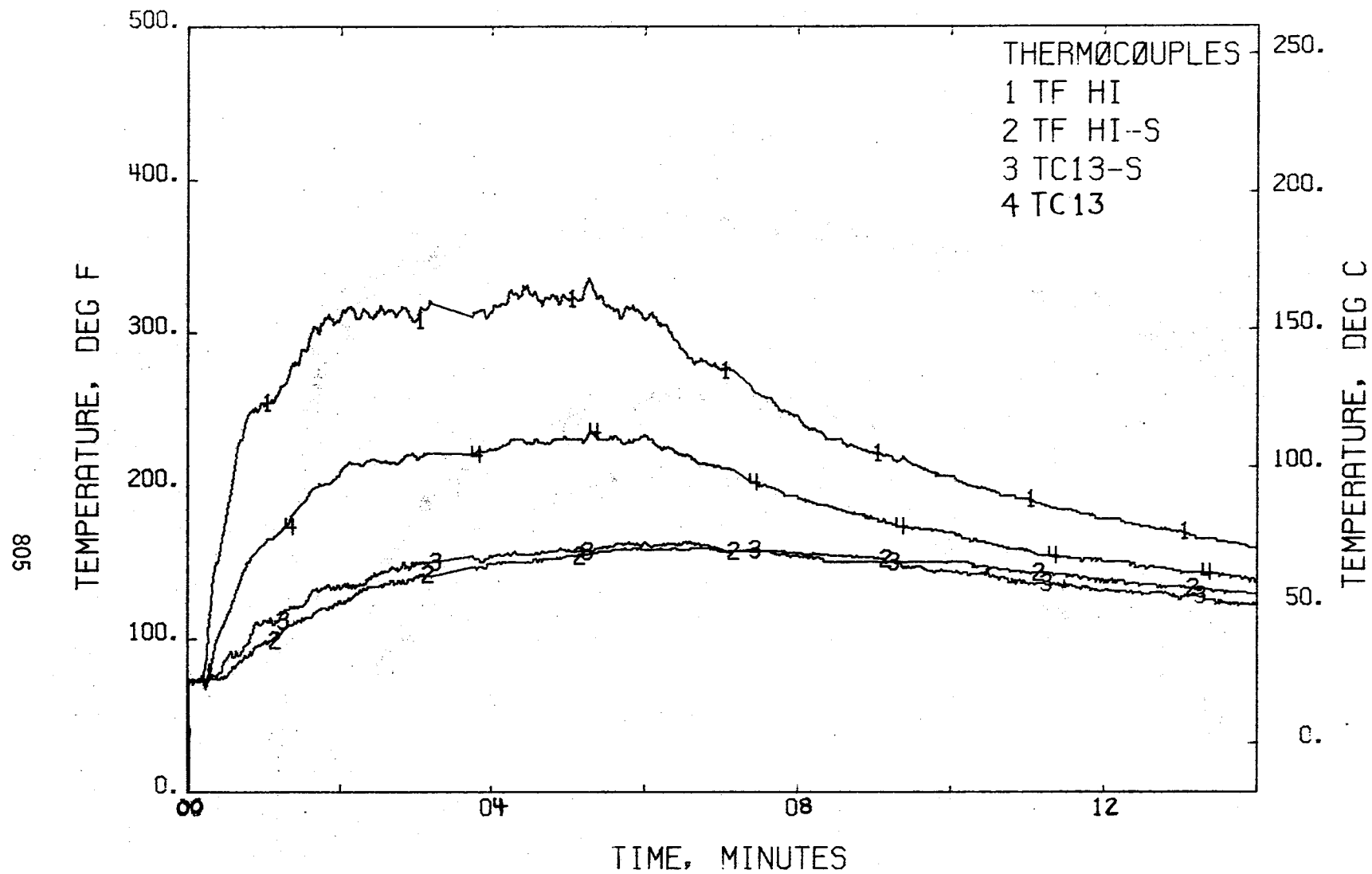


FIGURE 658 . - TEMPERATURES, SHIELDED VS UNSHIELDED T/C'S  
TEST 27

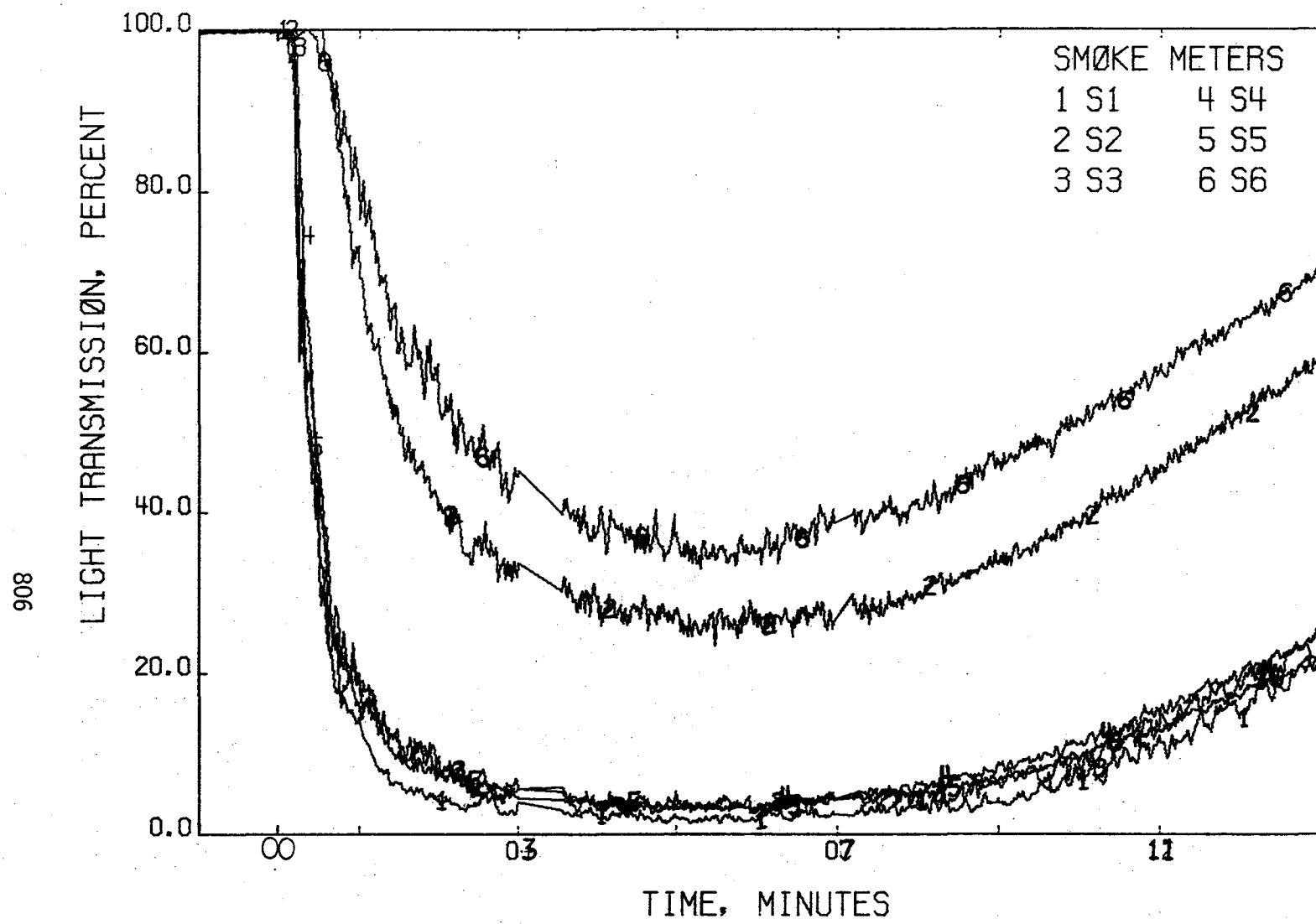


FIGURE 659 . - LIGHT TRANSMISSION  
TEST 27

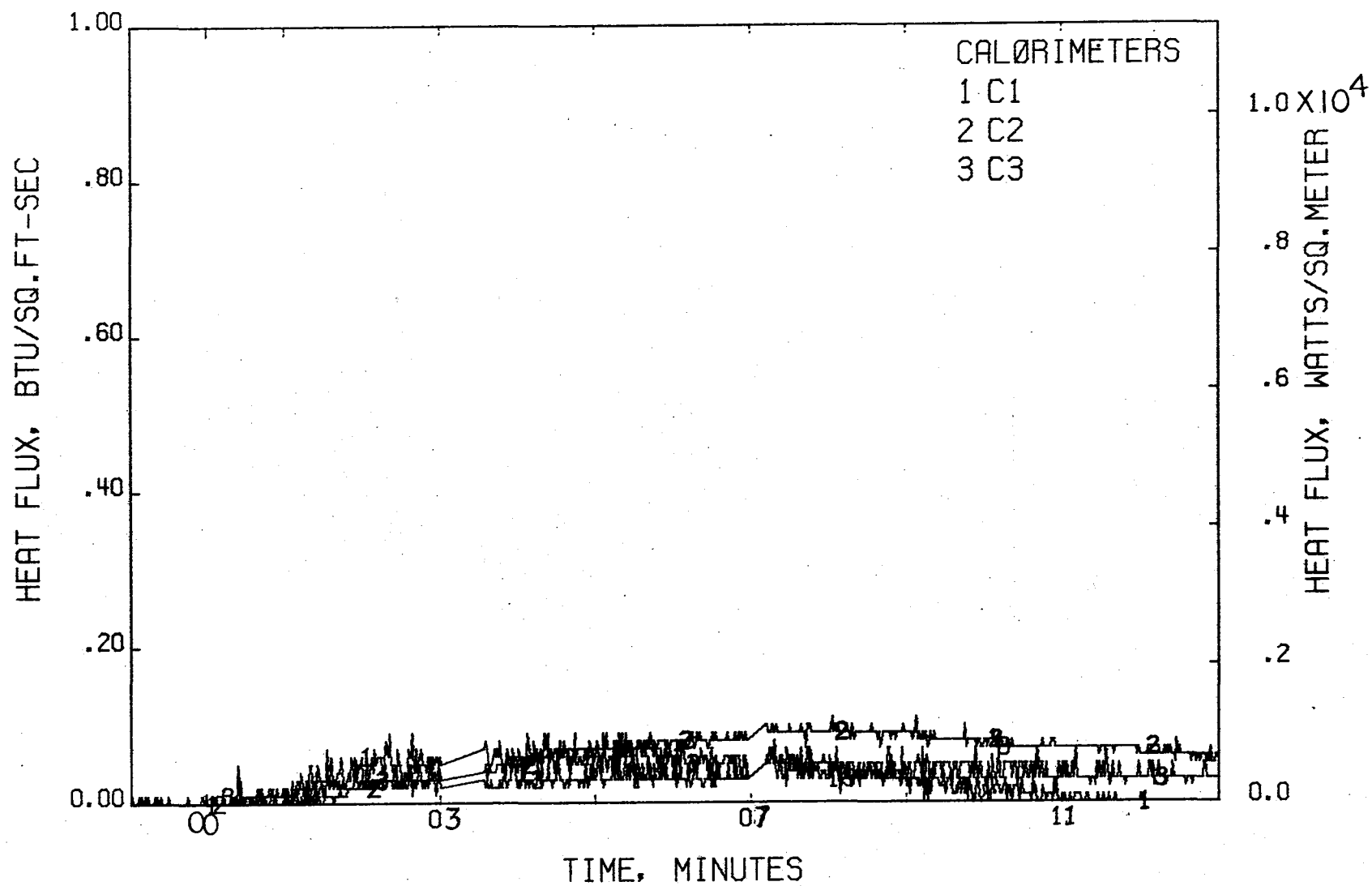
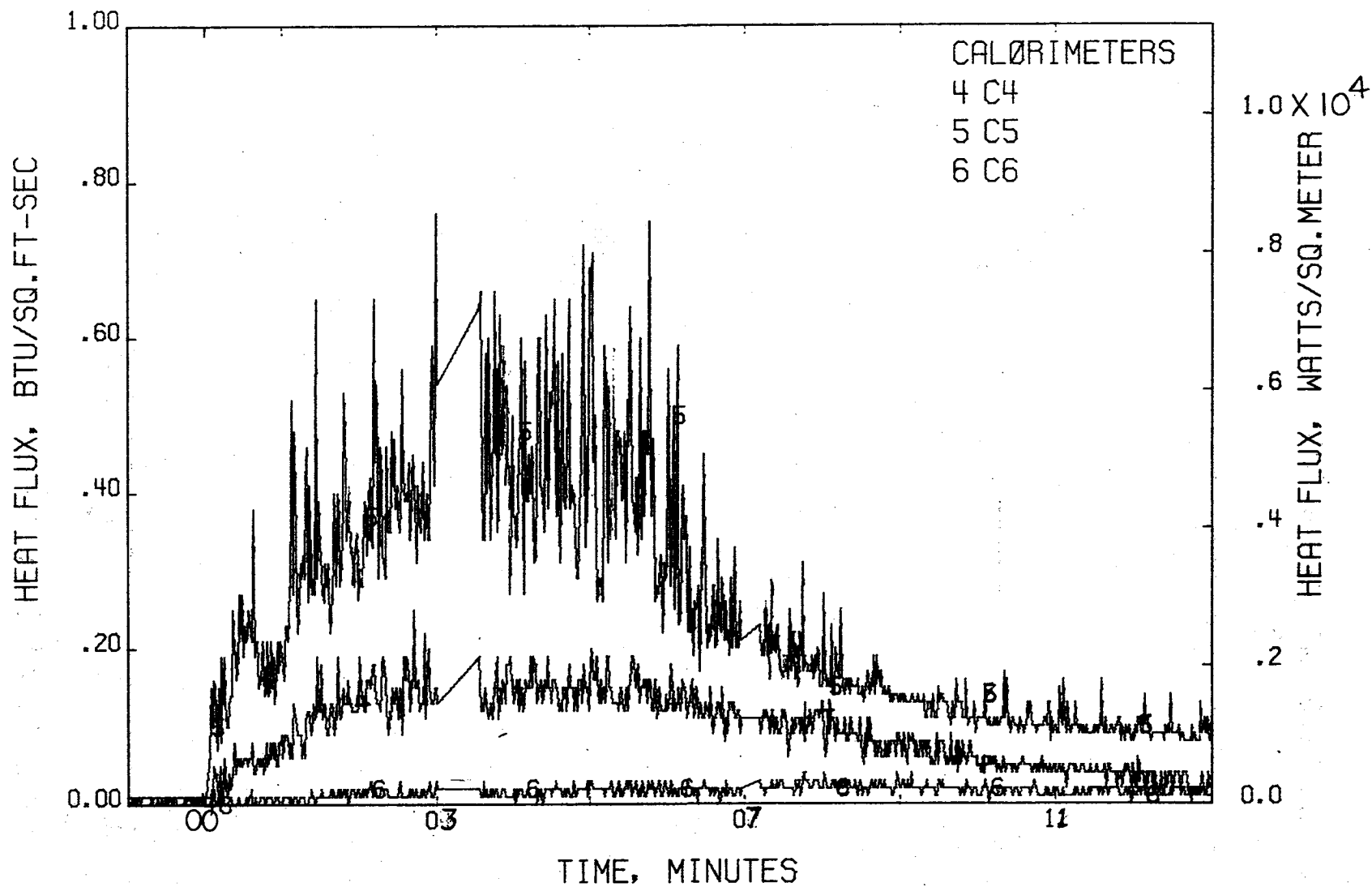


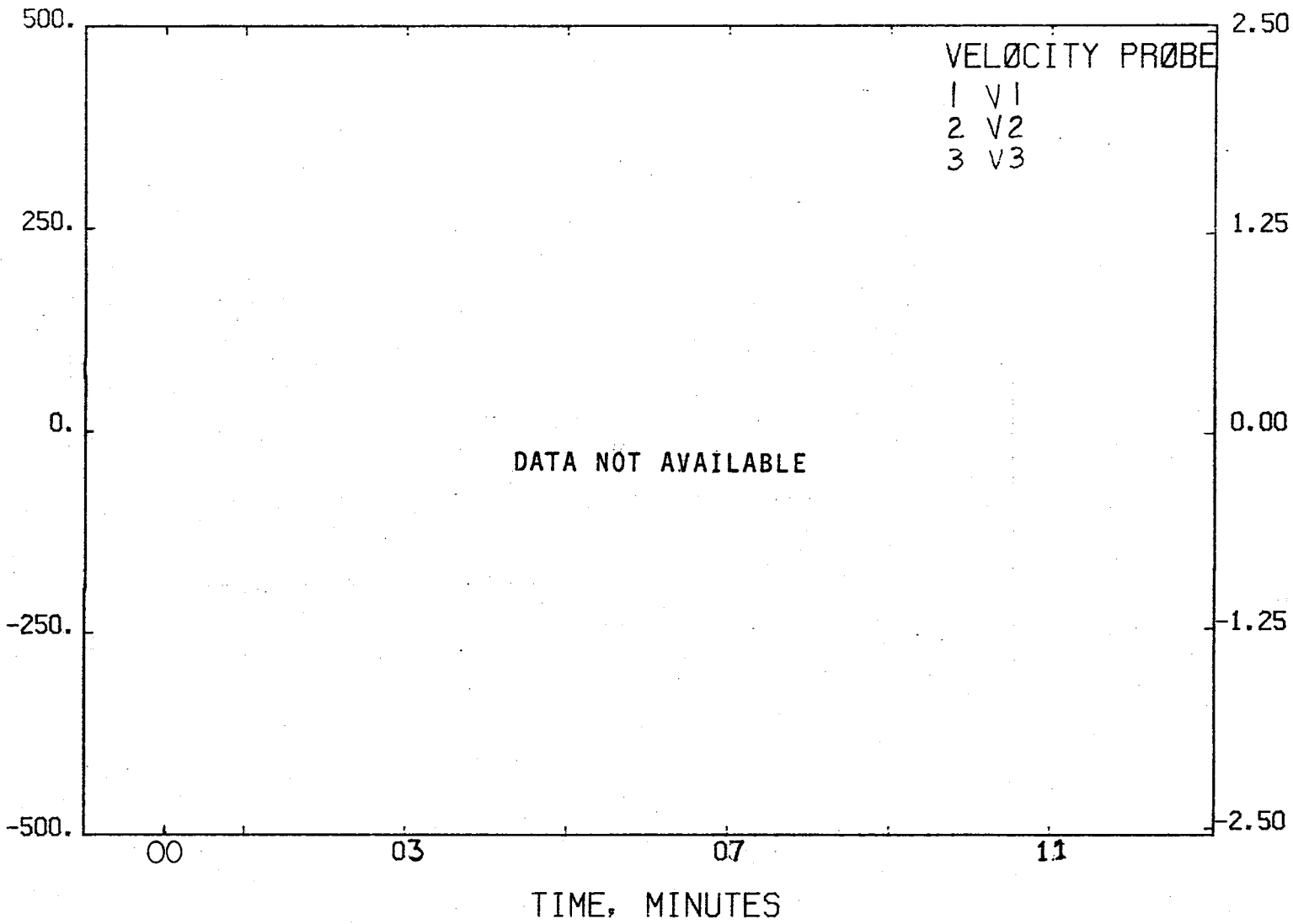
FIGURE 660 . - HEAT FLUX, AFT  
TEST 27





608

VELOCITY, FEET/MINUTE



AIR VELOCITY  
TEST 27

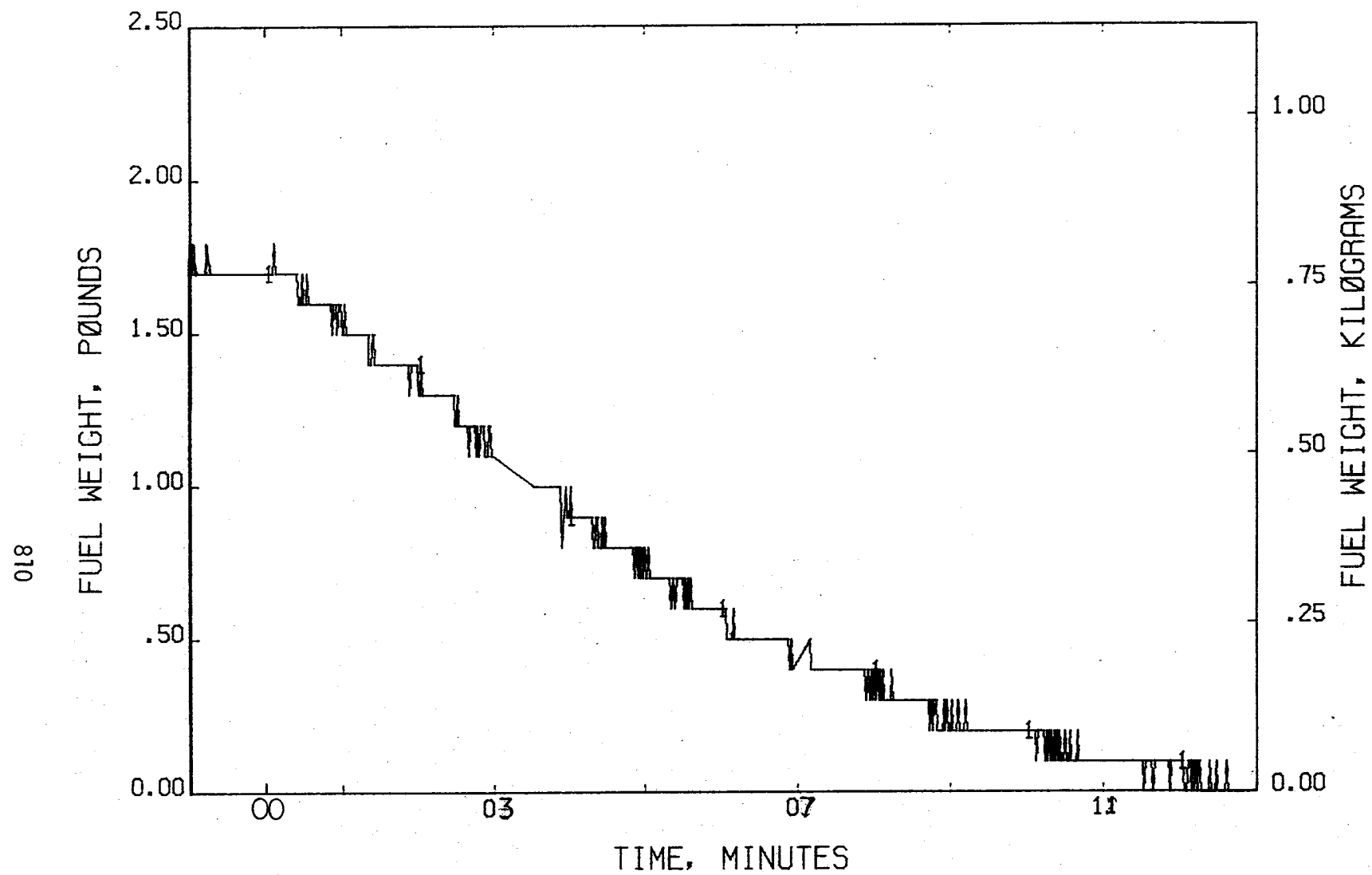


FIGURE 662 . - FUEL WEIGHT LOSS  
TEST 27

THE FOLLOWING HYDROLYZABLE GASES WERE NOT DETECTED IN THIS TEST  
ABOVE THE LEVELS STATED BELOW:

---

HYDROGEN CYANIDE - < 3 PPM  
HYDROGEN FLUORIDE - < 3 PPM  
HYDROGEN CHLORIDE - < 6 PPM

FIGURE 663 . - HYDROGEN CYANIDE, FLUORIDE, AND CHLORIDE CONCENTRATIONS  
TEST 27

DUE TO EQUIPMENT PROBLEMS, THE CONCENTRATIONS OF  
THE FOLLOWING NON-HYDROLYZABLE GASES WERE NOT  
OBTAINED IN THIS TEST:

---

- o CARBON MONOXIDE

CARBON MONOXIDE CONCENTRATIONS

TEST 27

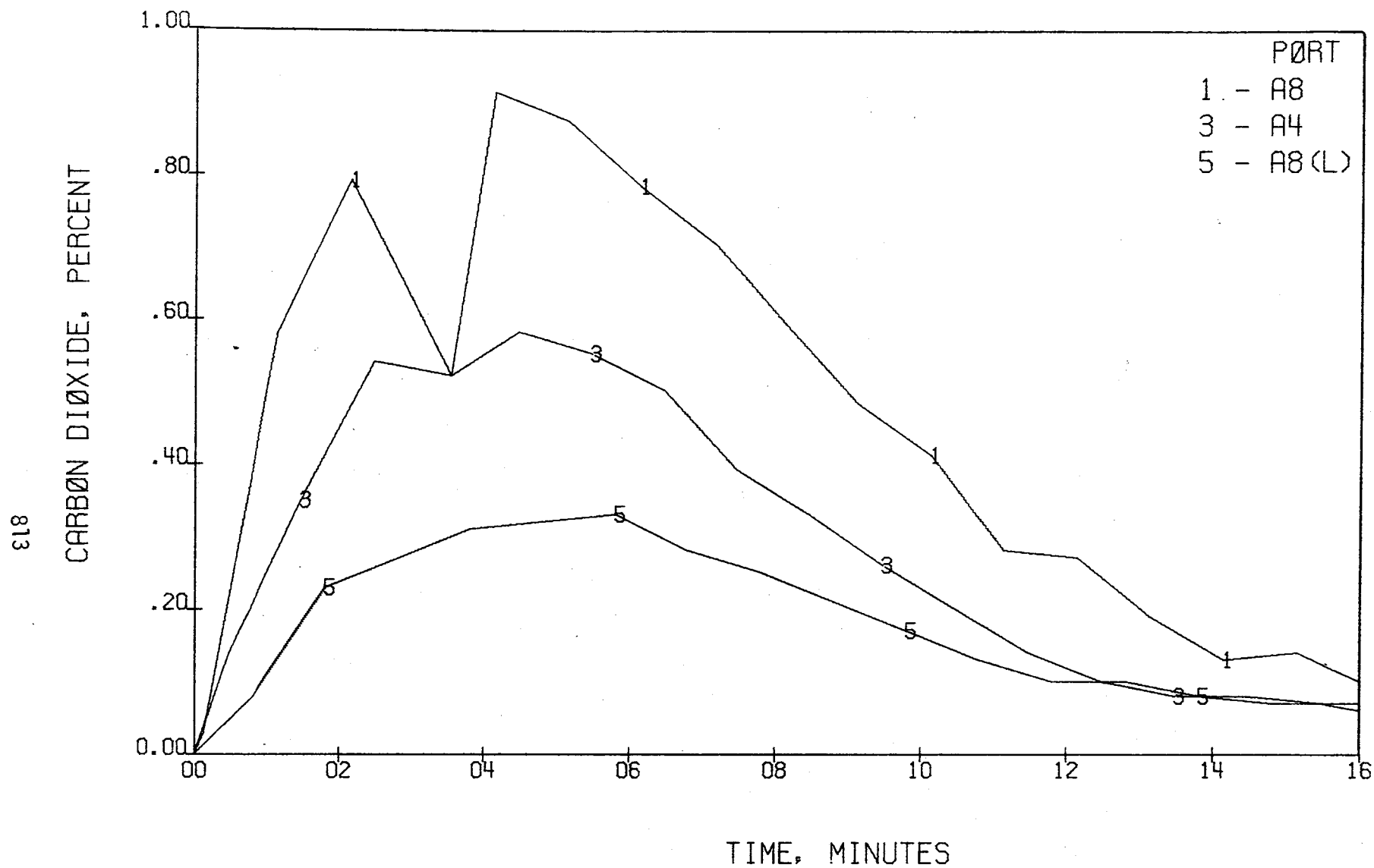


FIGURE 664 .-CARBON DIOXIDE CONCENTRATIONS, AFT  
TEST 27

814

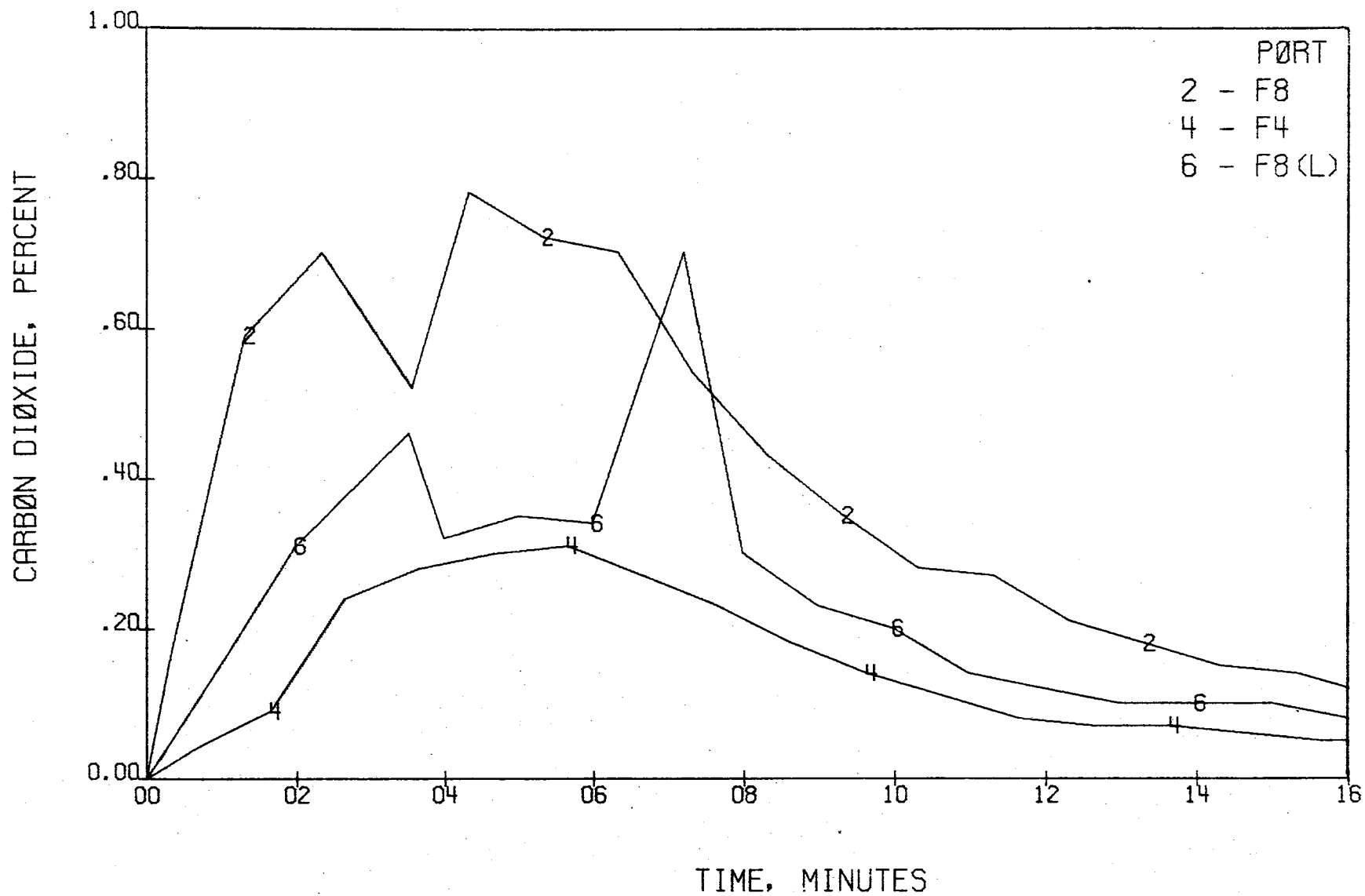


FIGURE 665 .- CARBON DIOXIDE CONCENTRATIONS, FØRE  
TEST 27

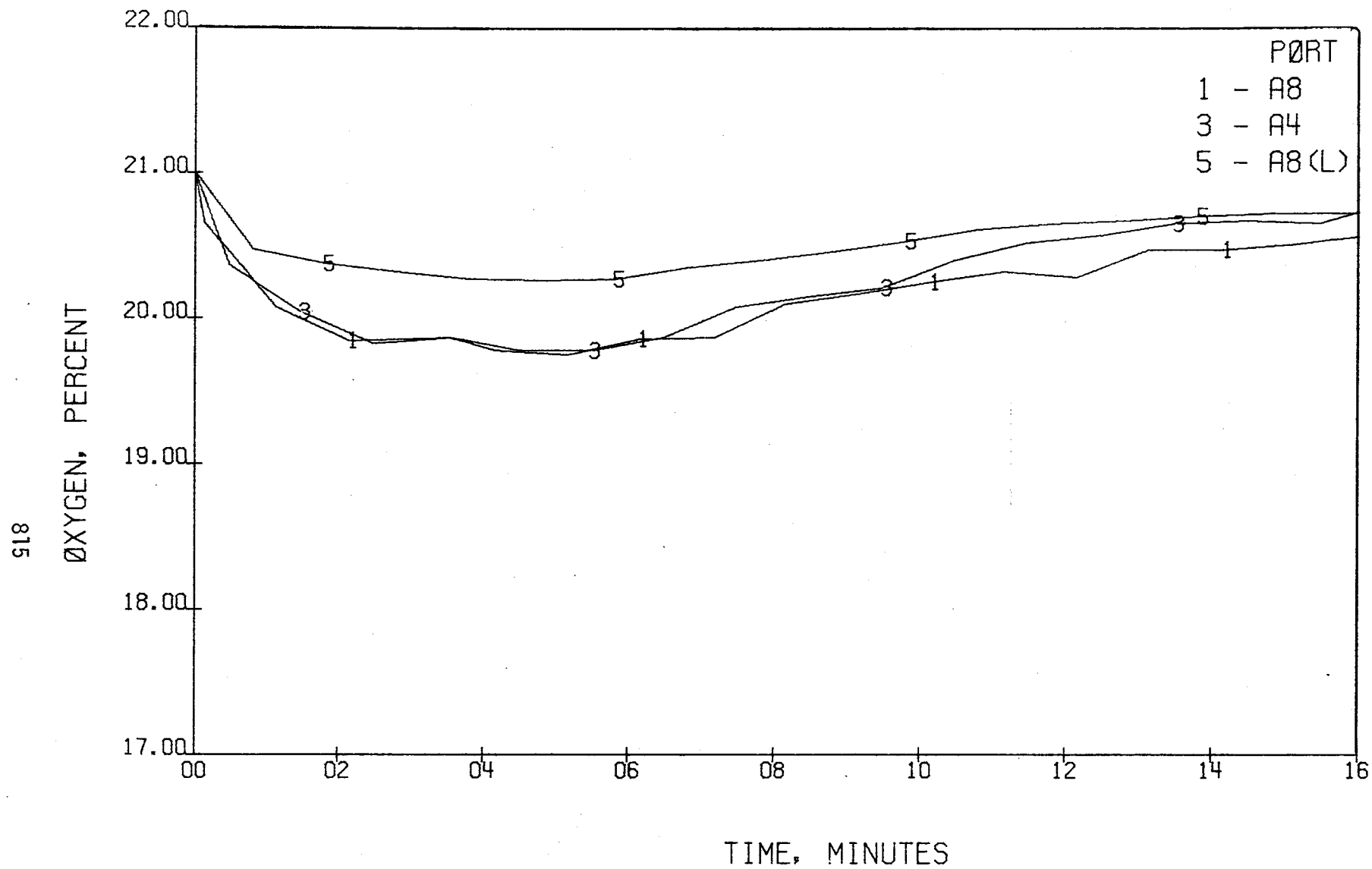


FIGURE 666 .- OXYGEN CONCENTRATIONS , AFT  
TEST 27

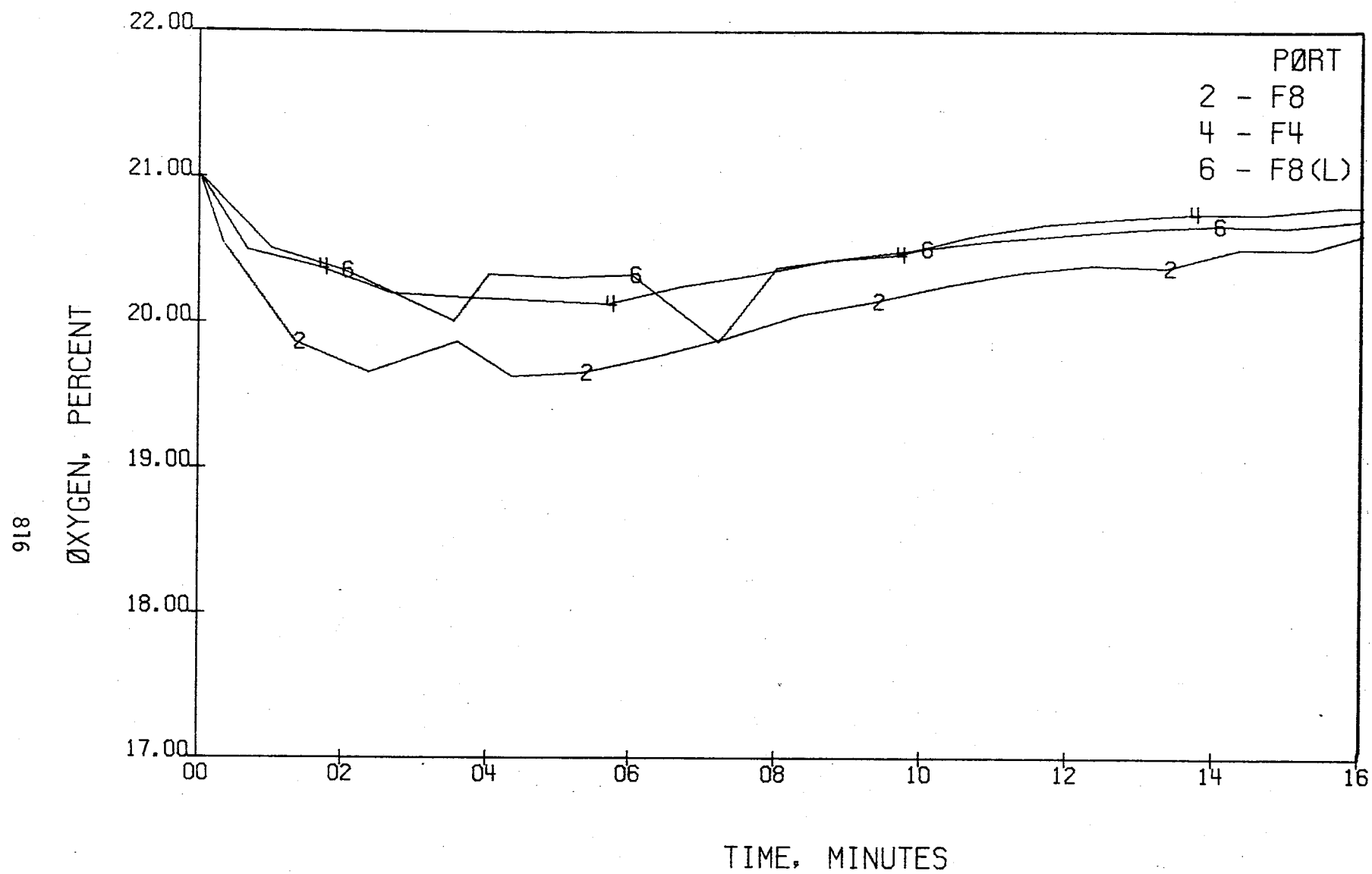


FIGURE 667 .- ØXYGEN CØNCENTRATIONS, FØRE  
TEST 27



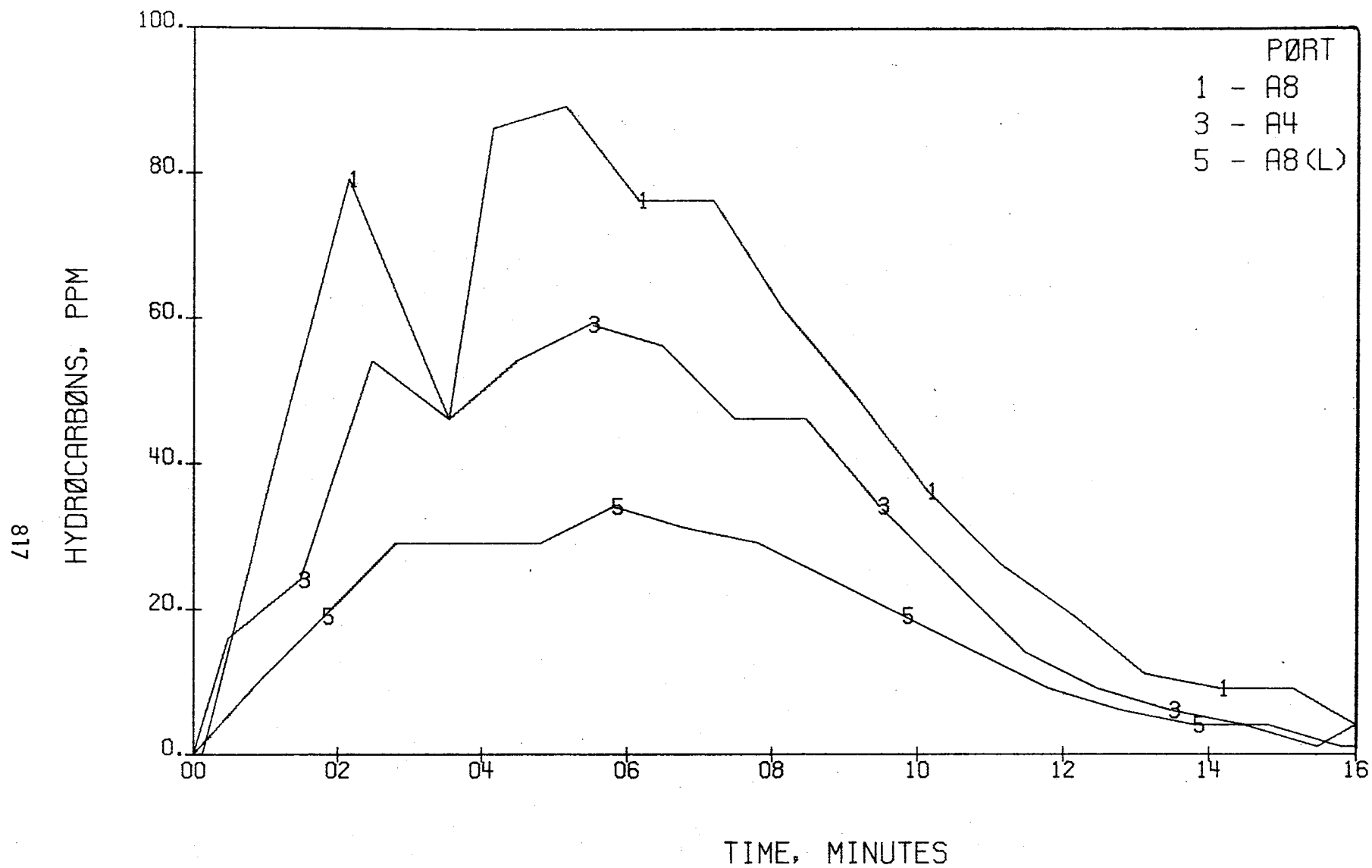


FIGURE 668 .- HYDROCARBONS CONCENTRATIONS , AFT  
TEST 27

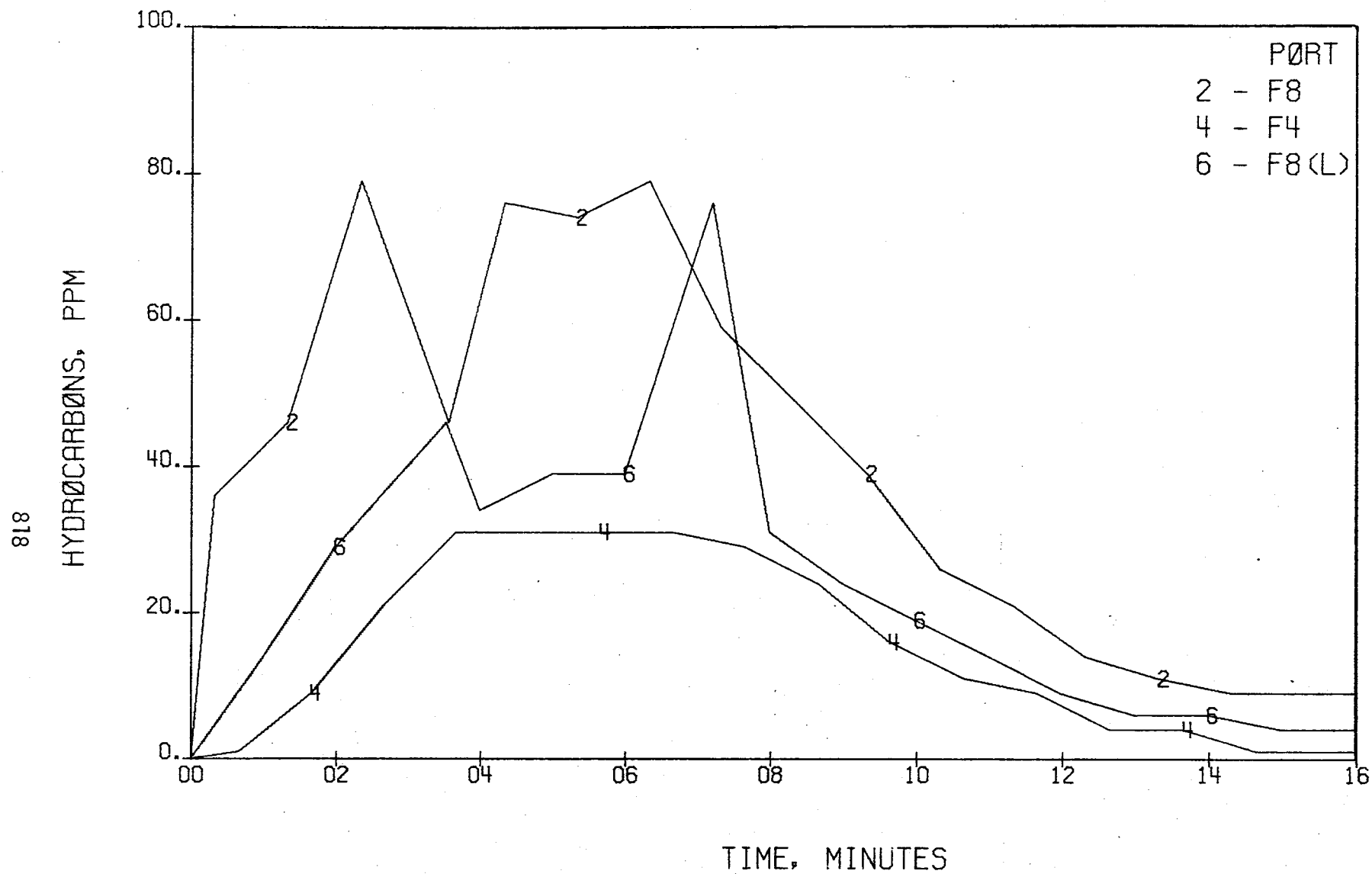


FIGURE 669 . - HYDROCARBONS CONCENTRATIONS , FØRE  
TEST 27

TEST 28

---

COVERED URETHANE FOAM SEATS & WALL, PSU,  
BIN, AND CEILING PANELS

NO PRE-TEST OR DURING-FIRE PHOTOS WERE TAKEN FOR TEST 28

---

(REFER TO TEST 24 PRE-TEST PHOTOS AS A REFERENCE)

## TEST 28

COVERED URETHANE FOAM SEATS & WALL, PSU,  
BIN, AND CEILING PANELS



FIGURE 670 . - POST-TEST CONFIGURATION, TEST 28

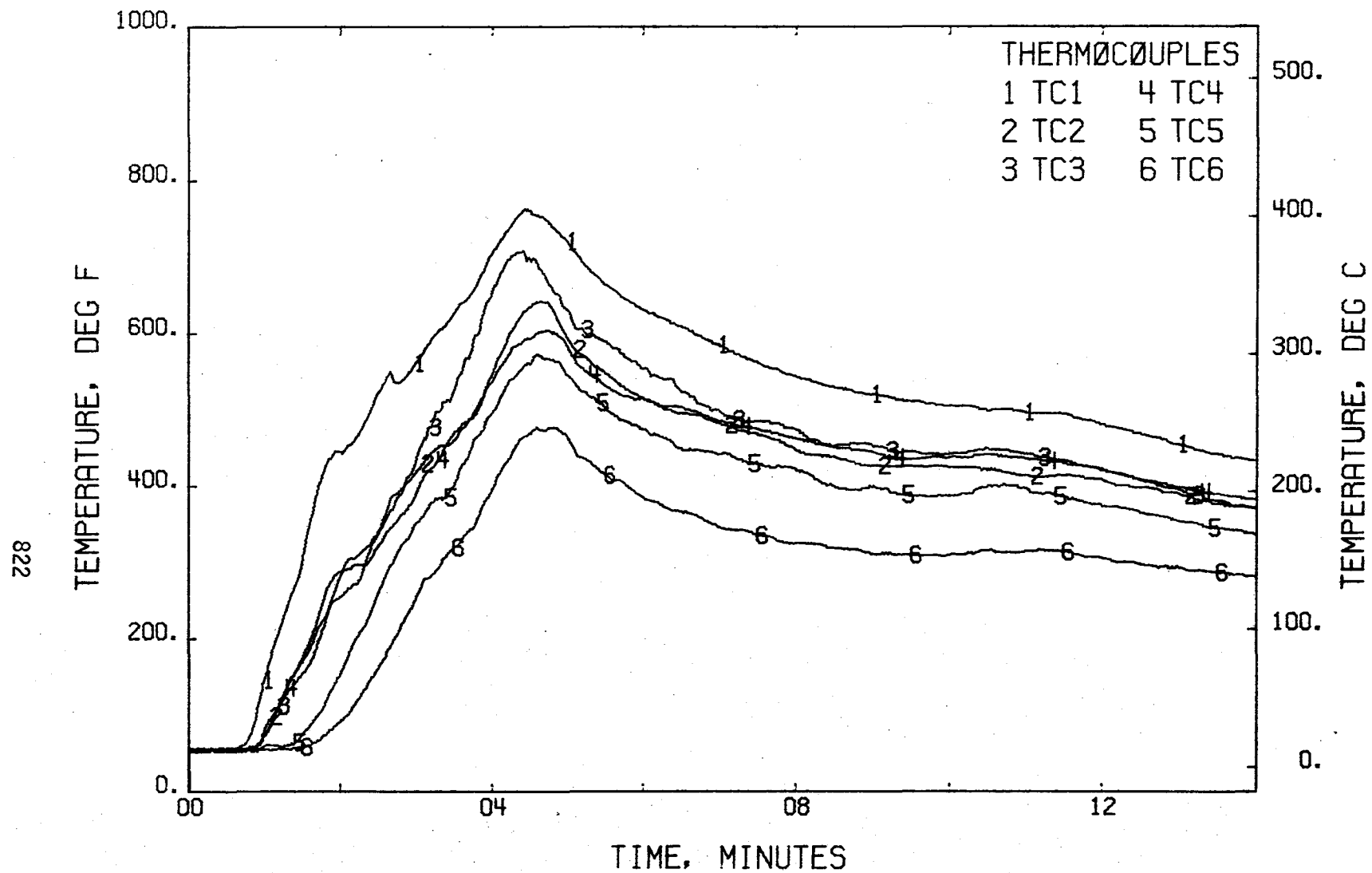


FIGURE 671 . - TEMPERATURES, T/C TREE 1  
TEST 28

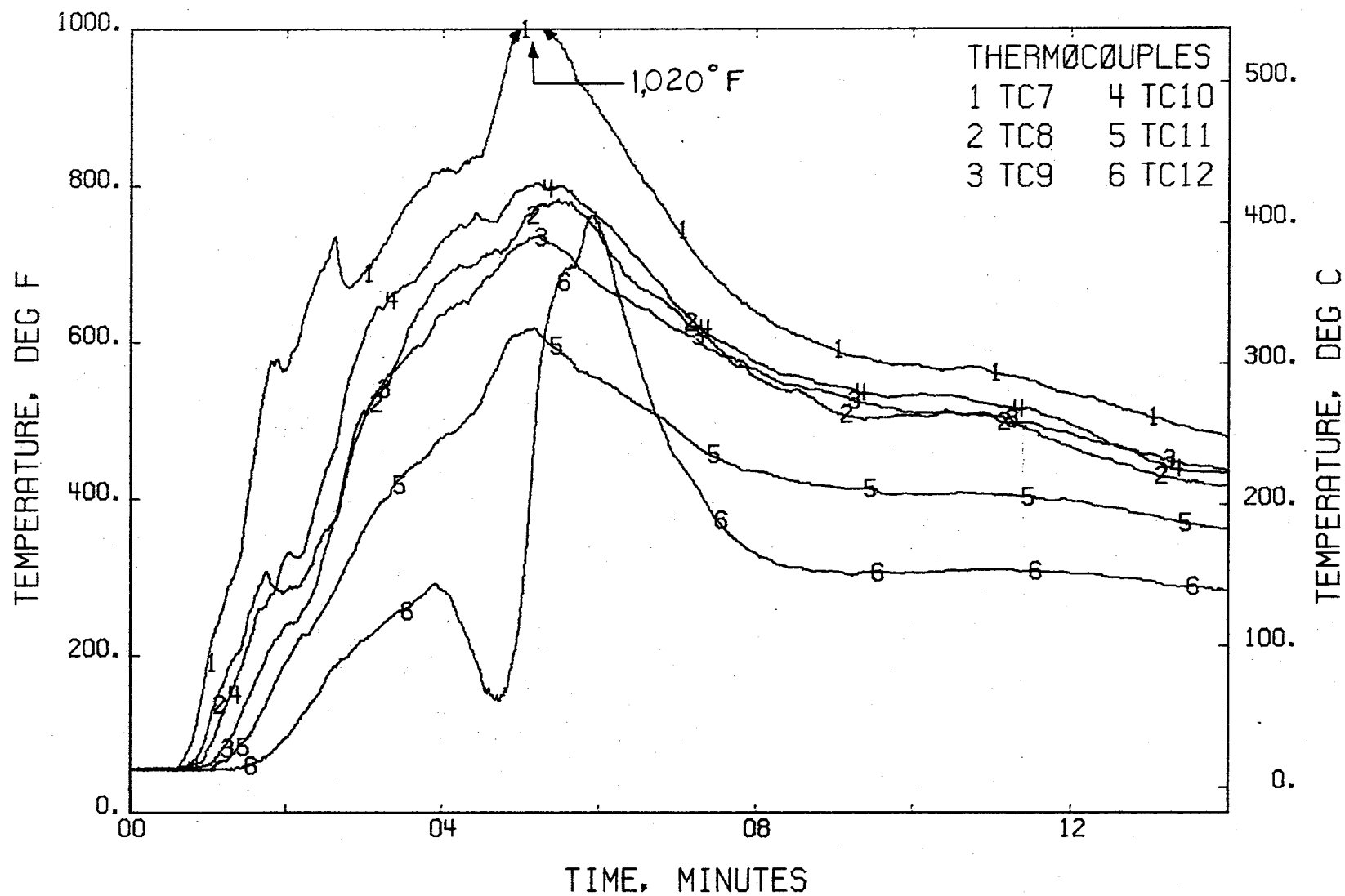


FIGURE 672 . - TEMPERATURES, T/C TREE 2  
TEST 28

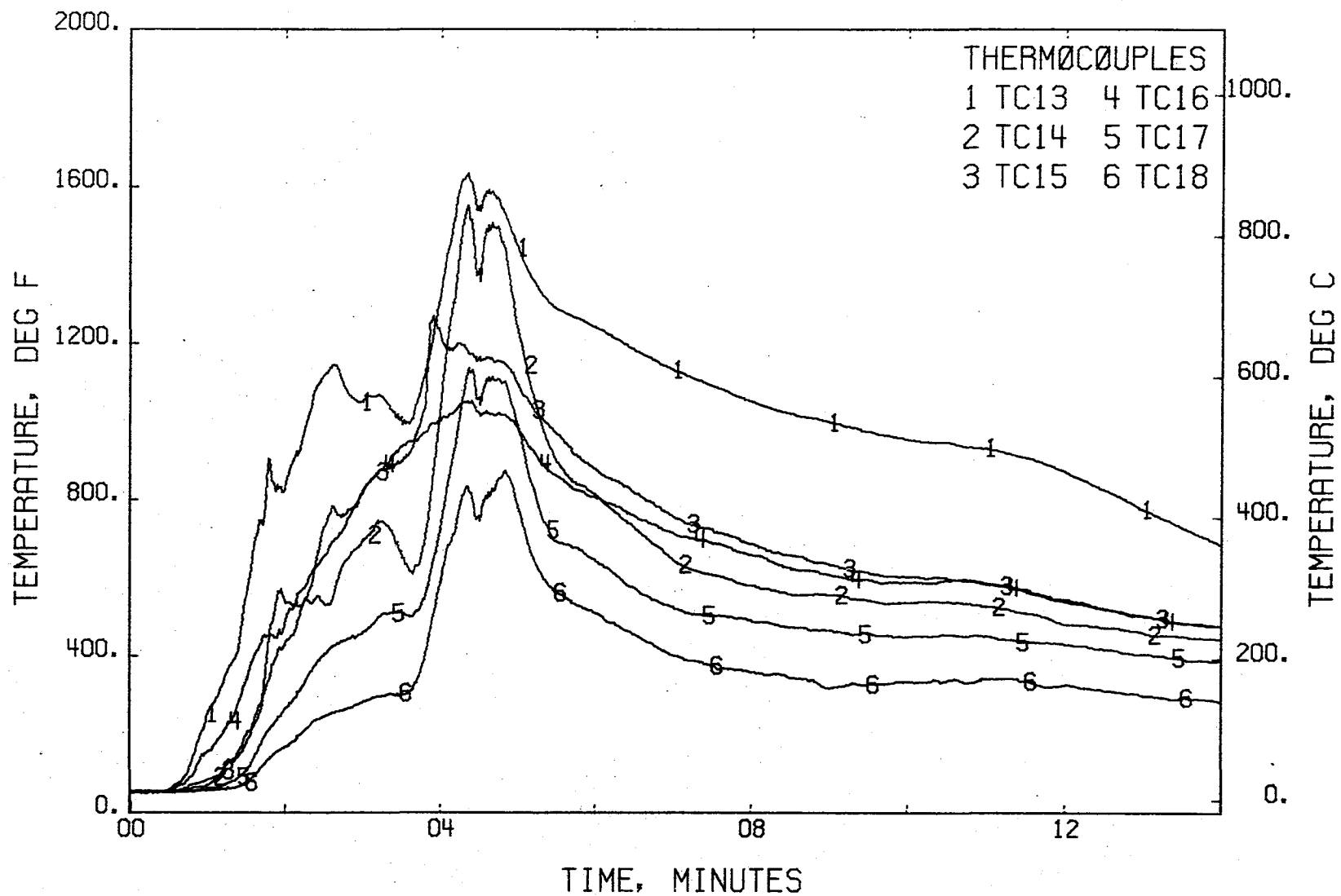


FIGURE 673 . - TEMPERATURES, T/C TREE 3  
TEST 28



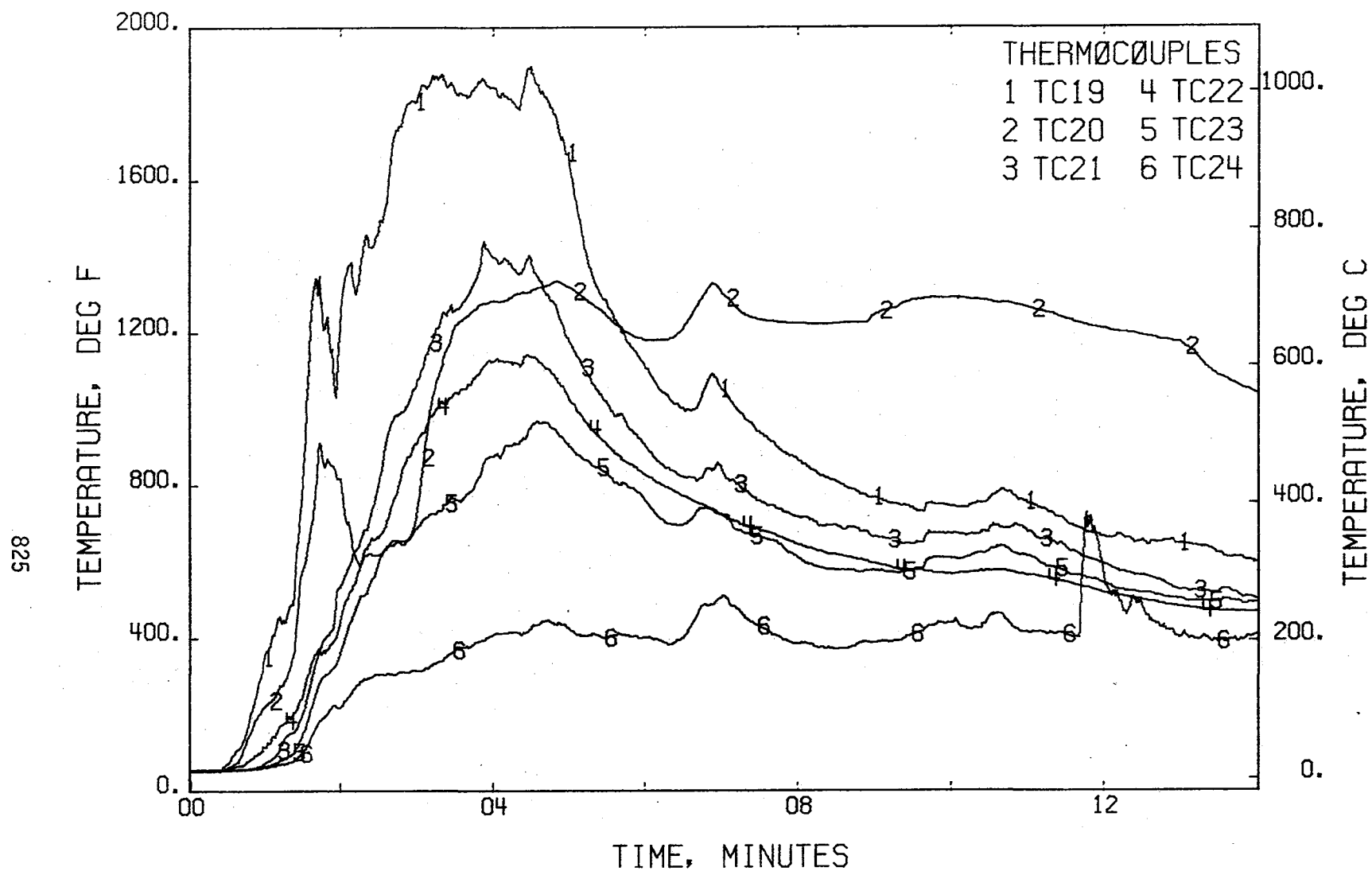


FIGURE 674 . - TEMPERATURES, T/C TREE 4  
TEST 28

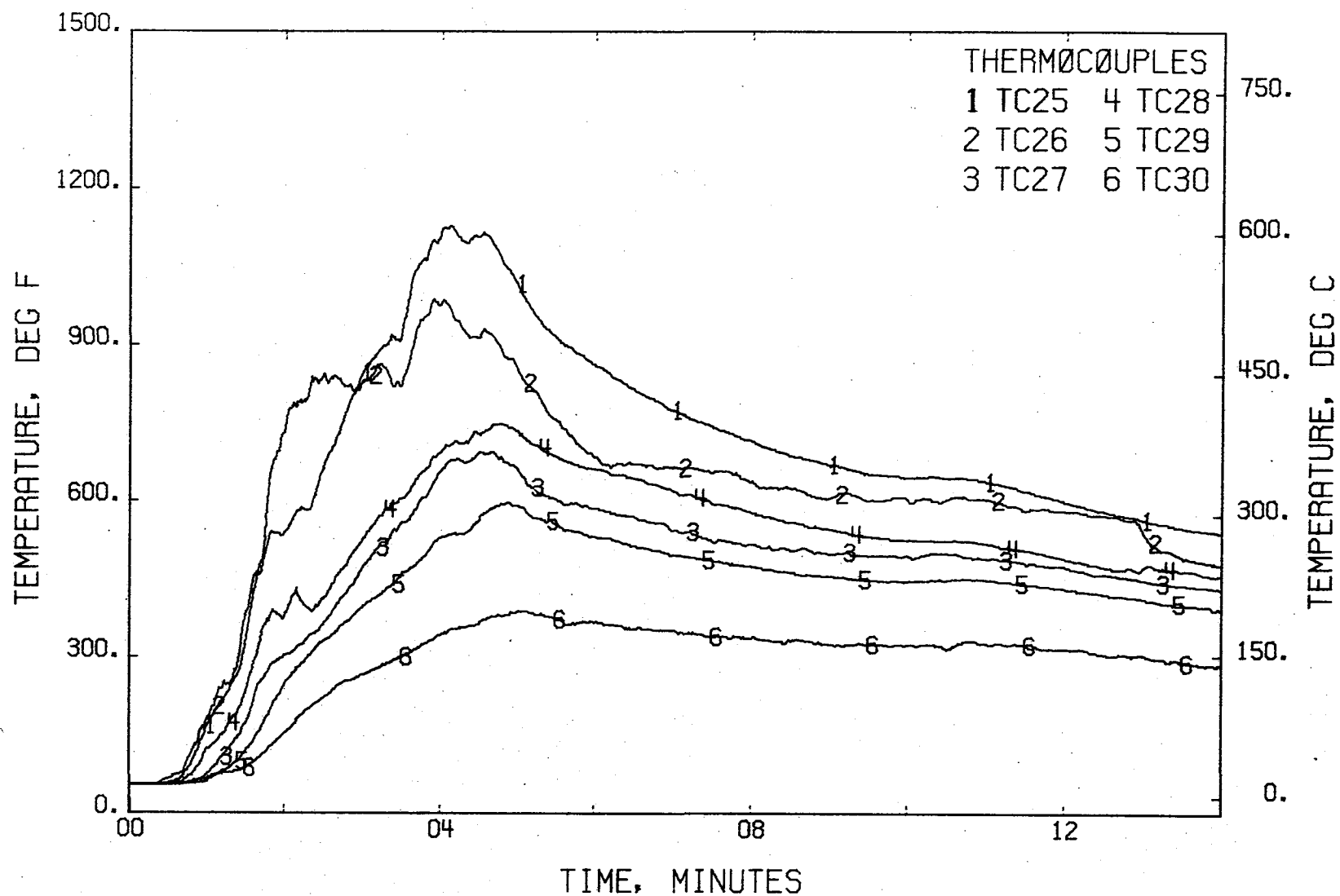


FIGURE 675 . - TEMPERATURES, T/C TREE 5  
TEST 28

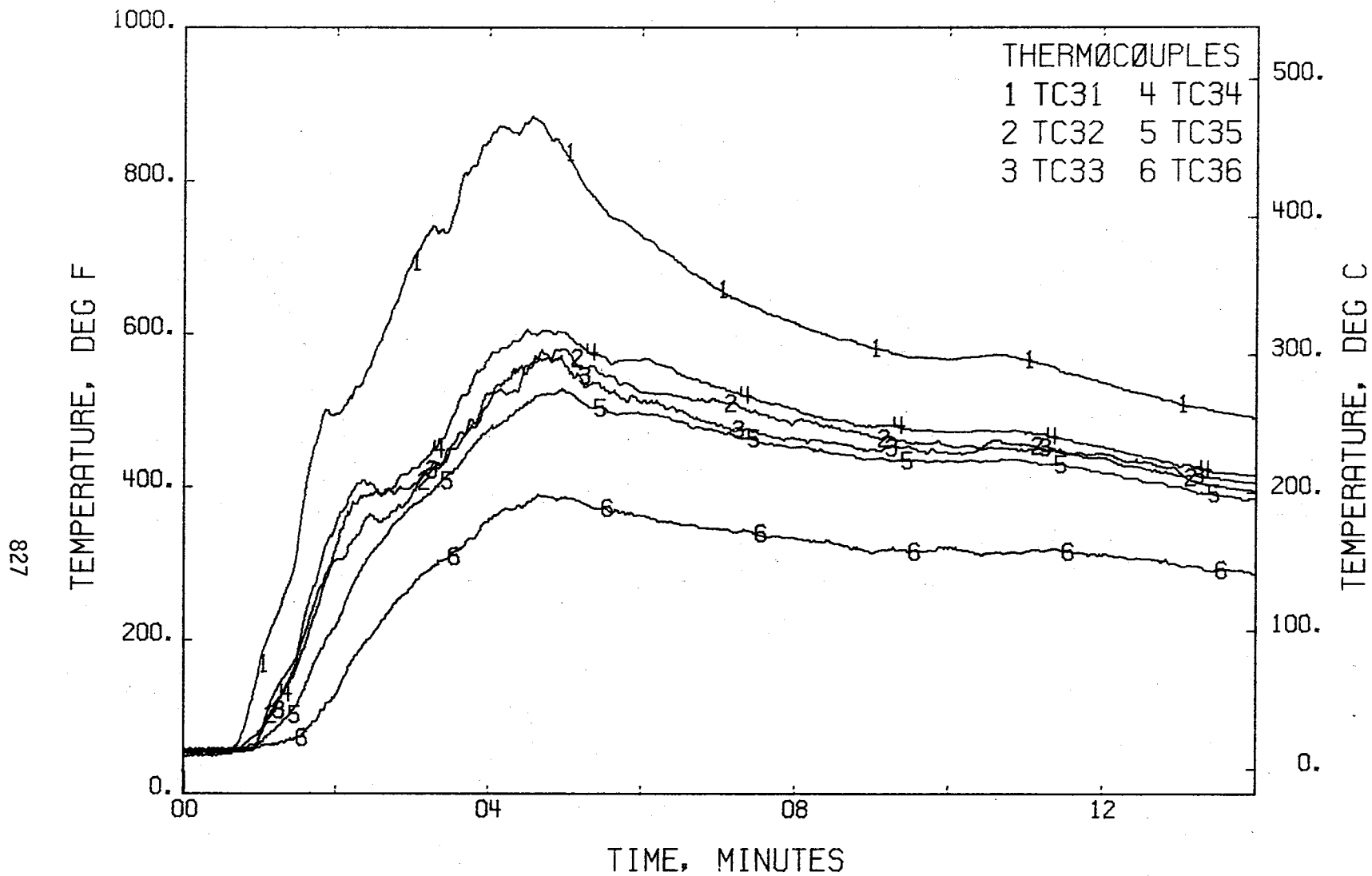


FIGURE 676 . - TEMPERATURES, T/C TREE 6  
TEST 28

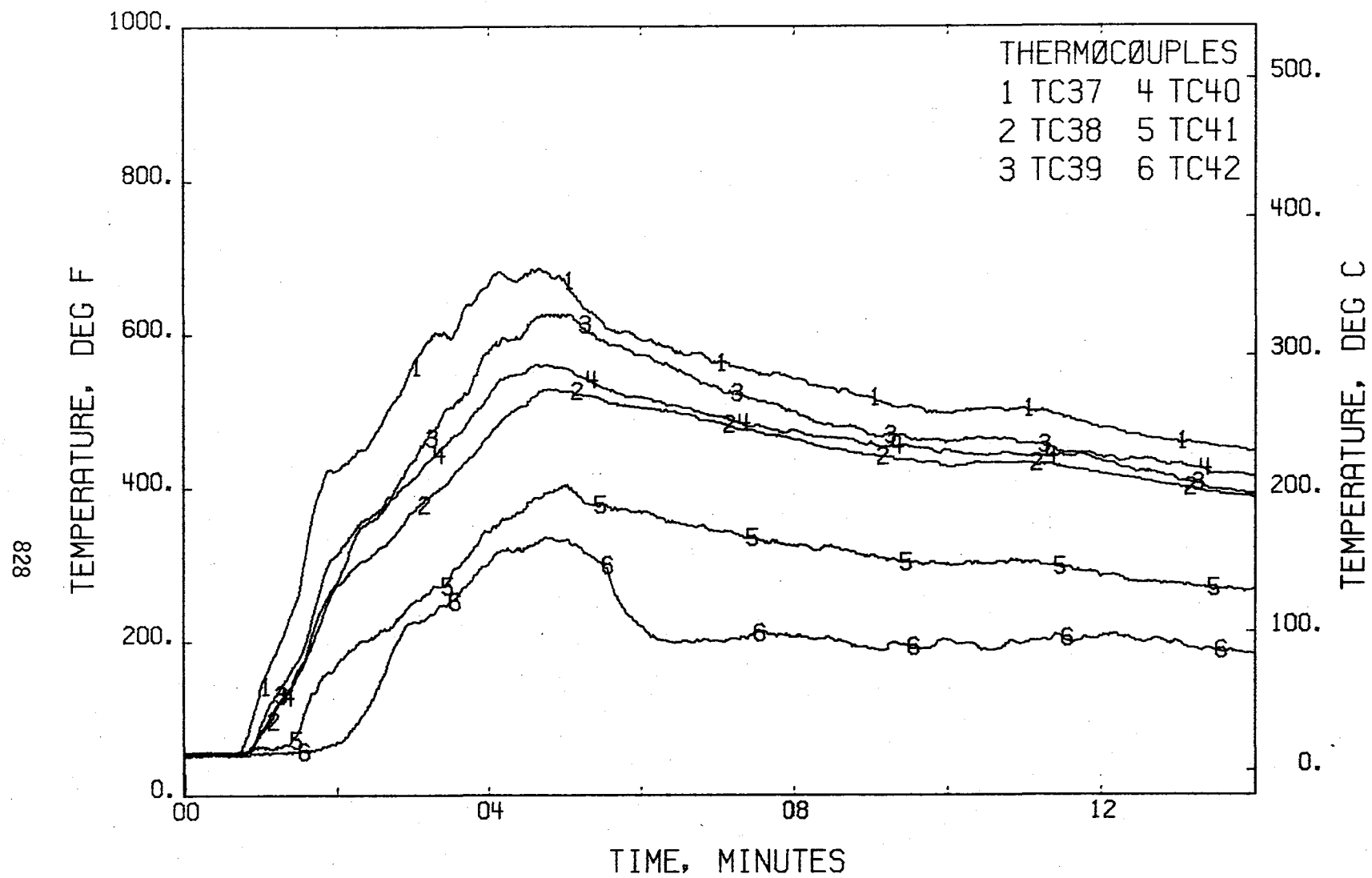


FIGURE 677 . - TEMPERATURES, T/C TREE 7  
TEST 28

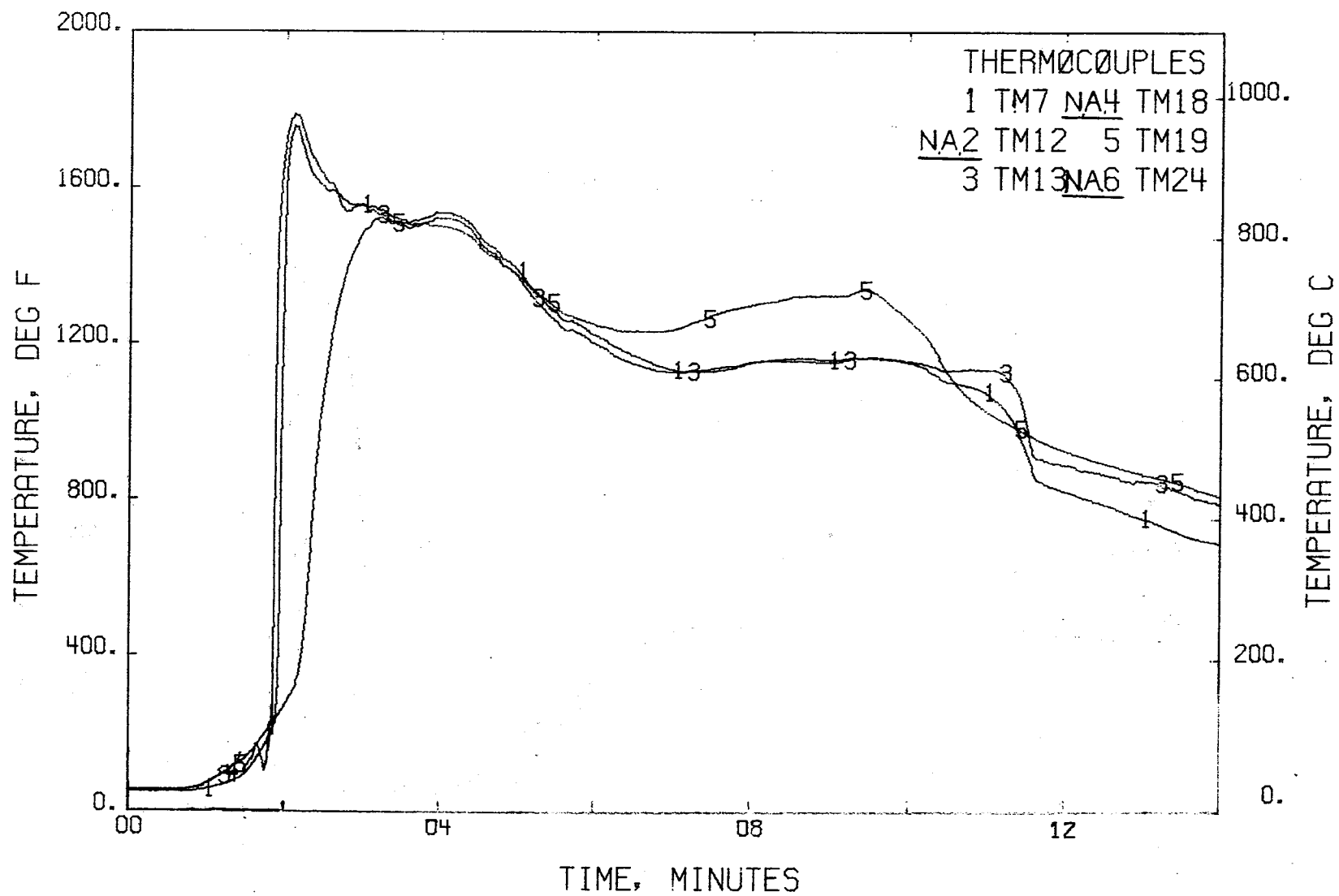


FIGURE 678 . - TEMPERATURES, PSU  
TEST 28

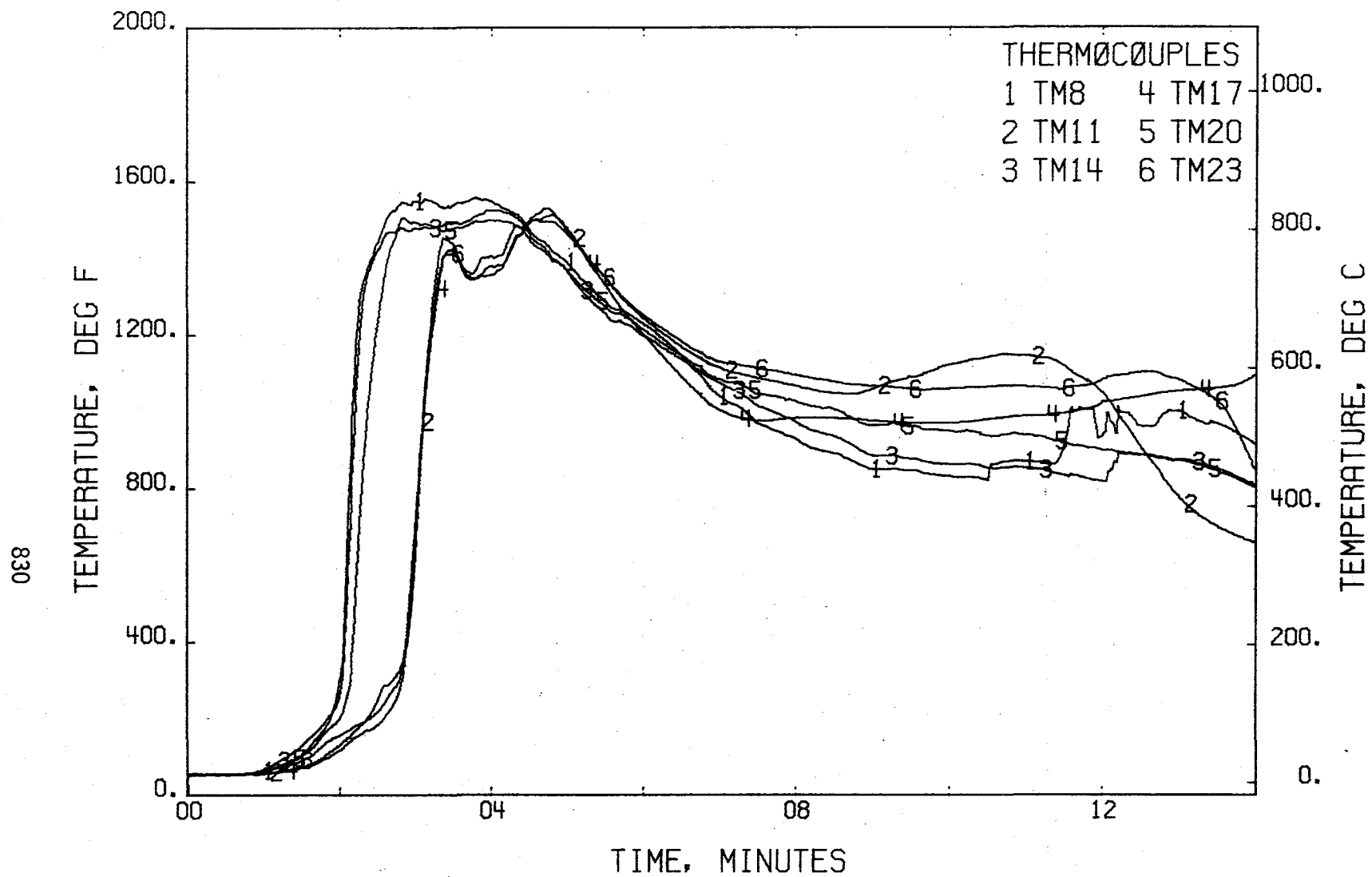


FIGURE 679 . - TEMPERATURES, STORAGE BINS  
TEST 28

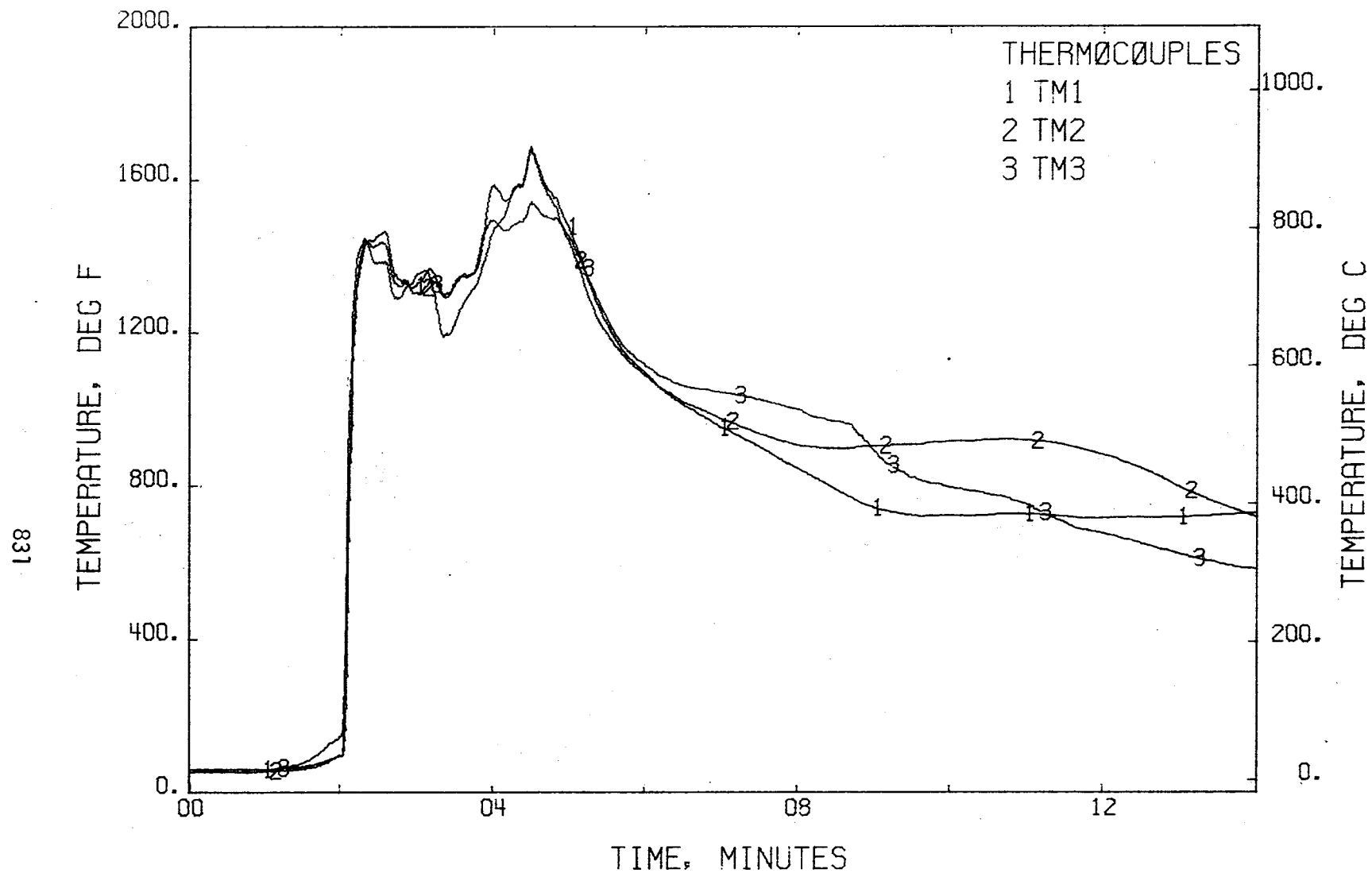


FIGURE 680 . - TEMPERATURES, CEILING PANELS (AFT)  
TEST 28

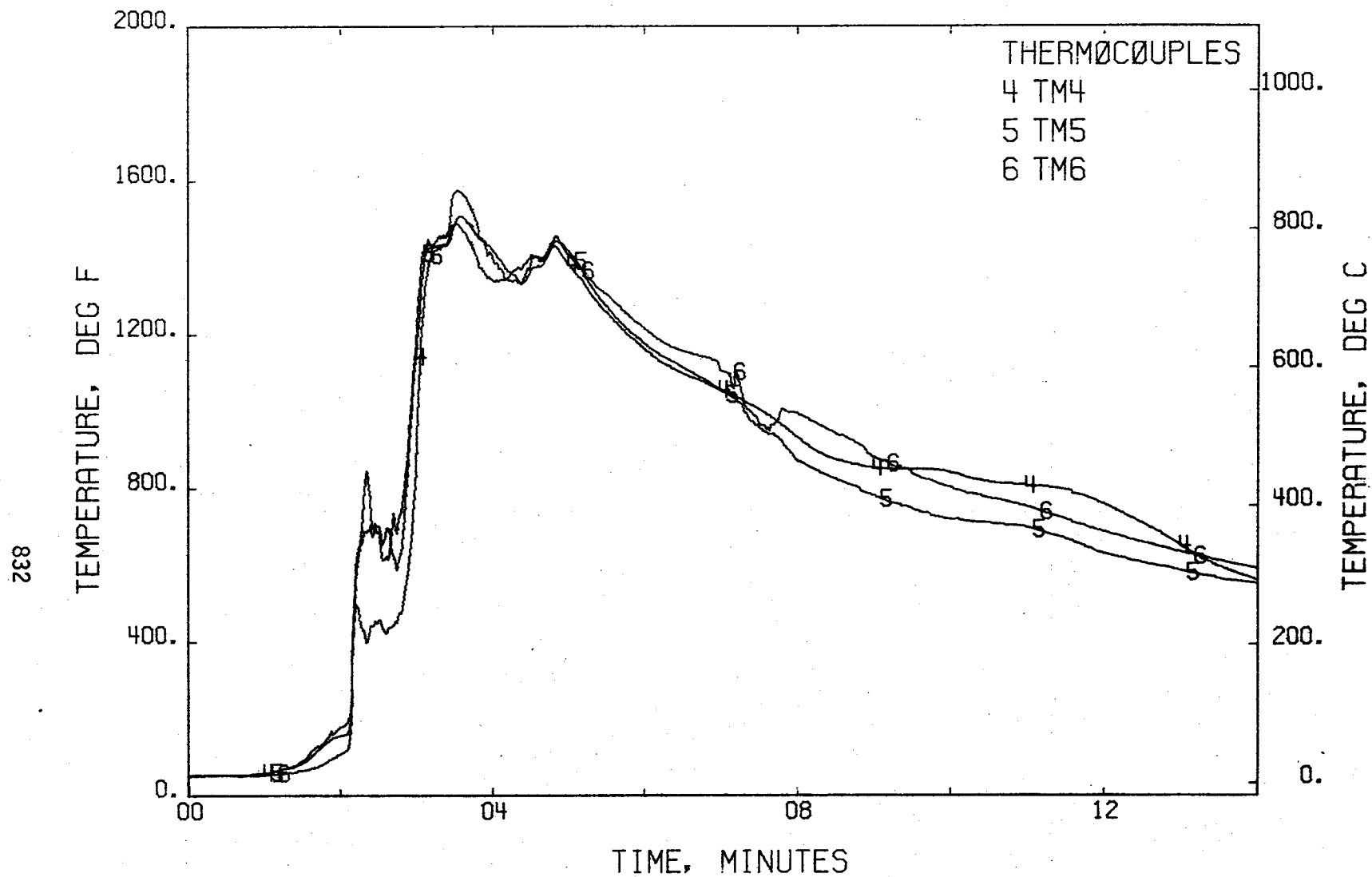


FIGURE 680 . - TEMPERATURES, CEILING PANELS (AFT) - CONT.  
TEST 28



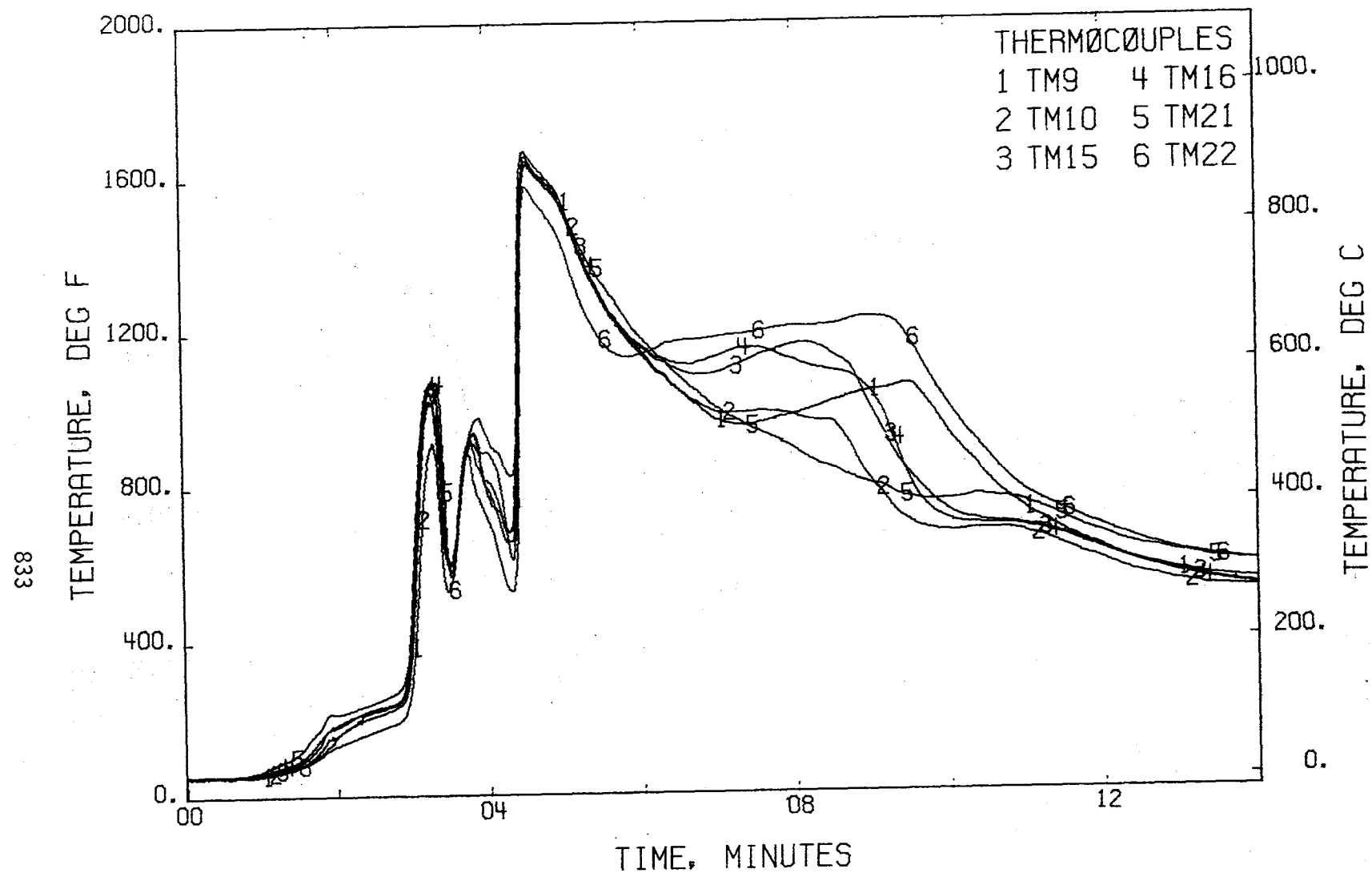


FIGURE 681 . - TEMPERATURES, CEILING PANEL (CENTER)  
TEST 28

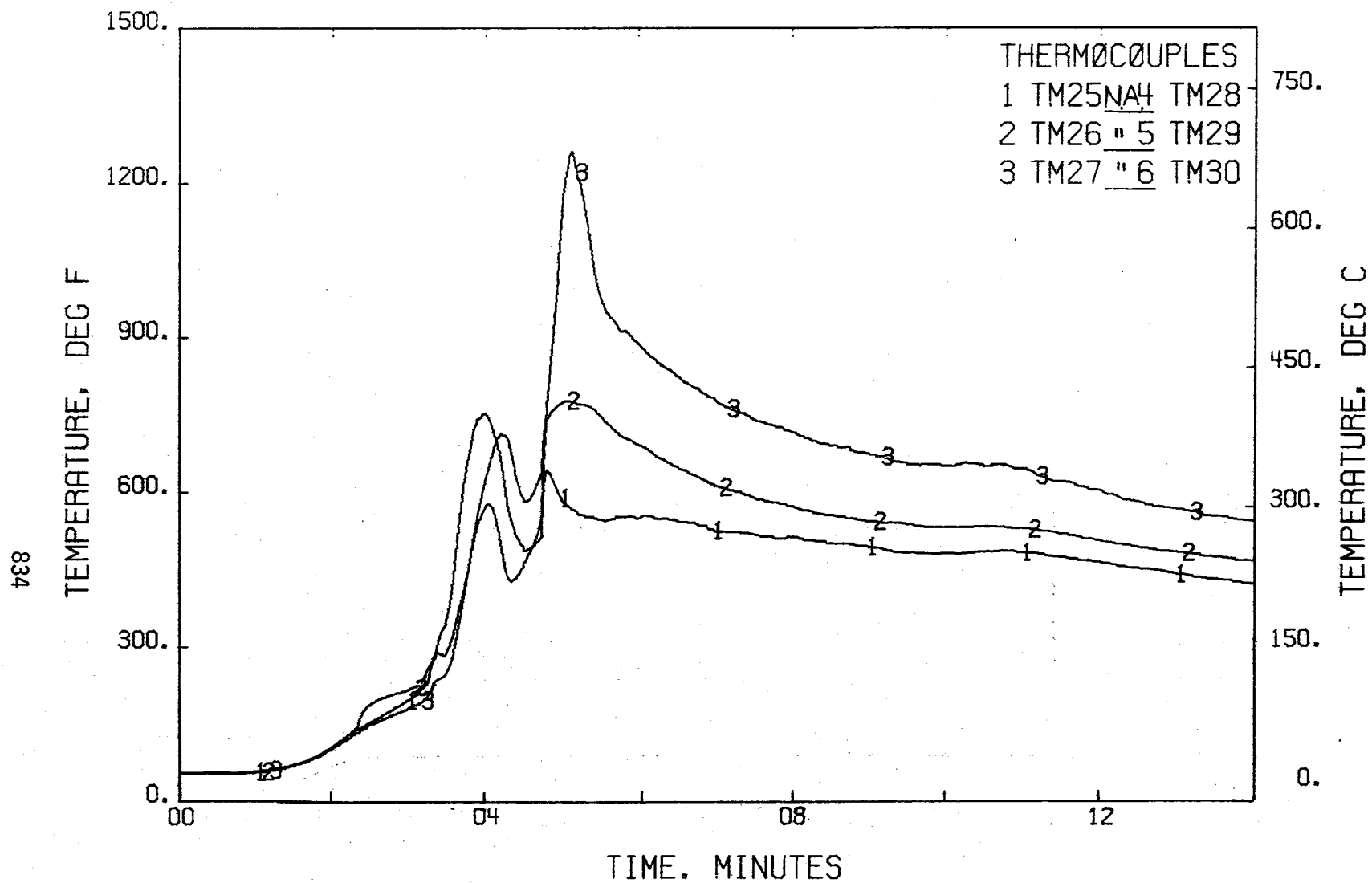


FIGURE 682 . - TEMPERATURES, CEILING PANELS (FORWARD)  
TEST 28

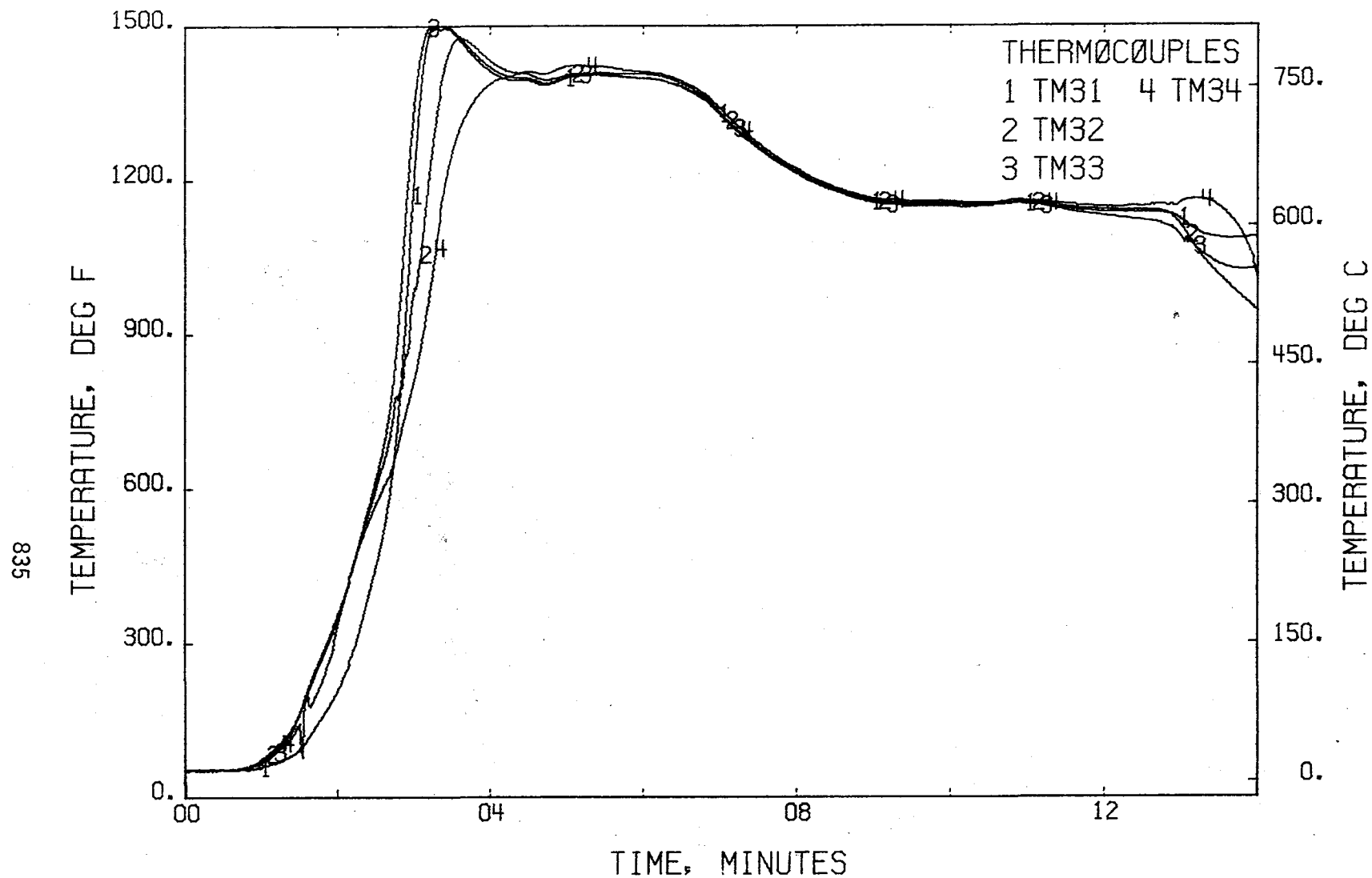


FIGURE 683 . - TEMPERATURES, SIDEWALL PANEL (TOP)  
TEST 28

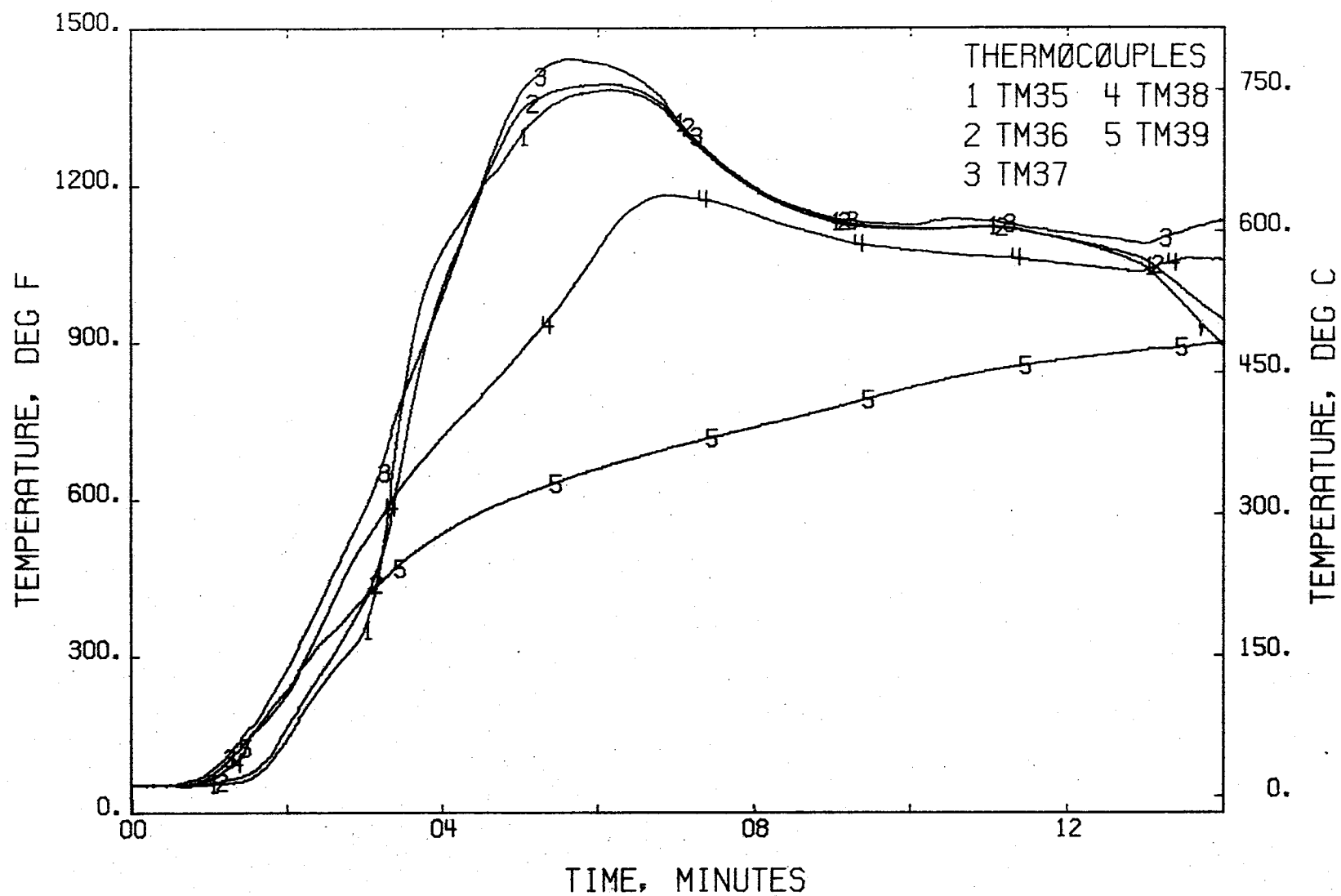


FIGURE 684 . - TEMPERATURES, SIDEWALL PANEL (CENTER)  
TEST 28

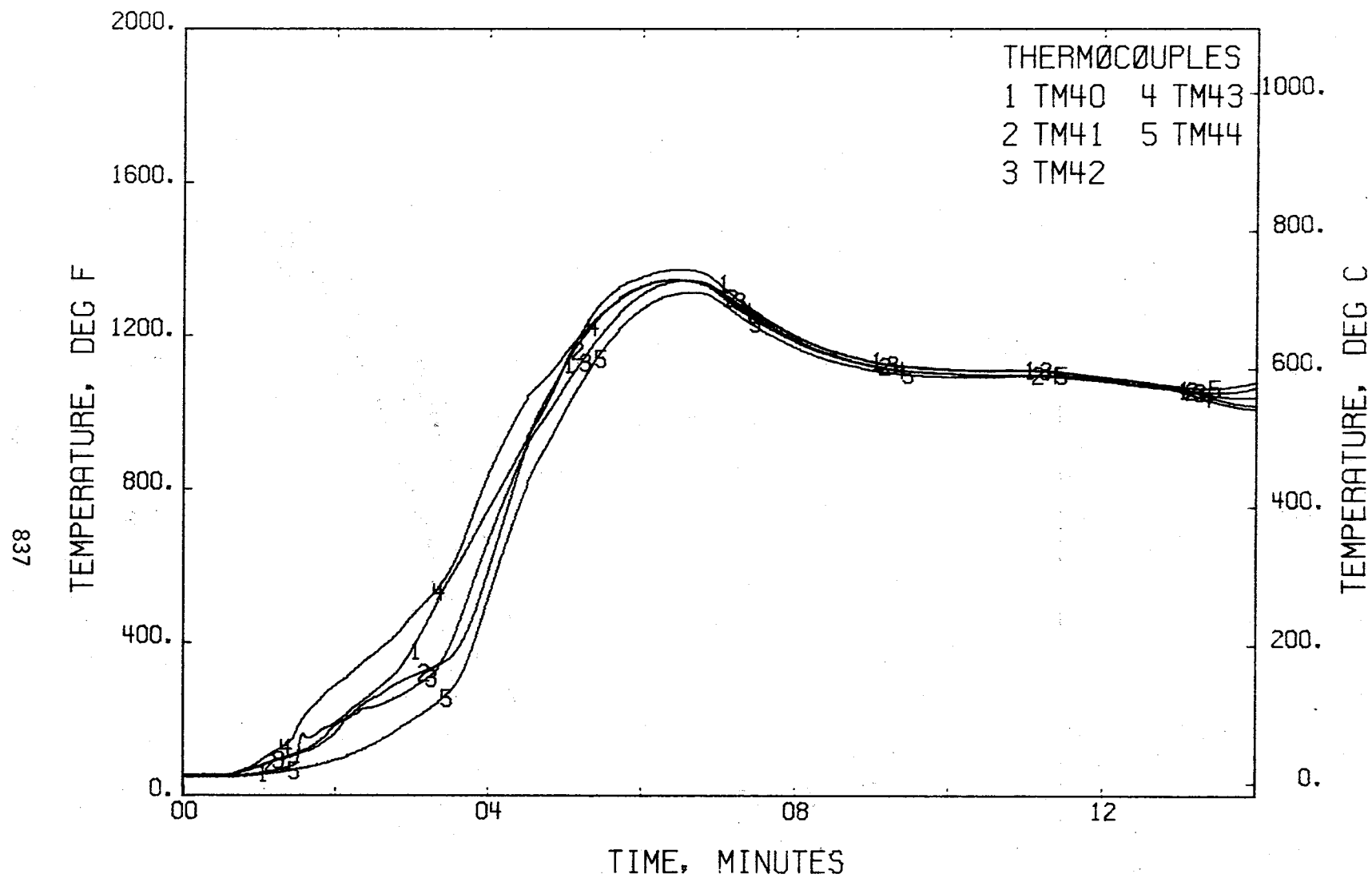


FIGURE 685 . - TEMPERATURES, SIDEWALL PANEL (BOTTOM)  
TEST 28

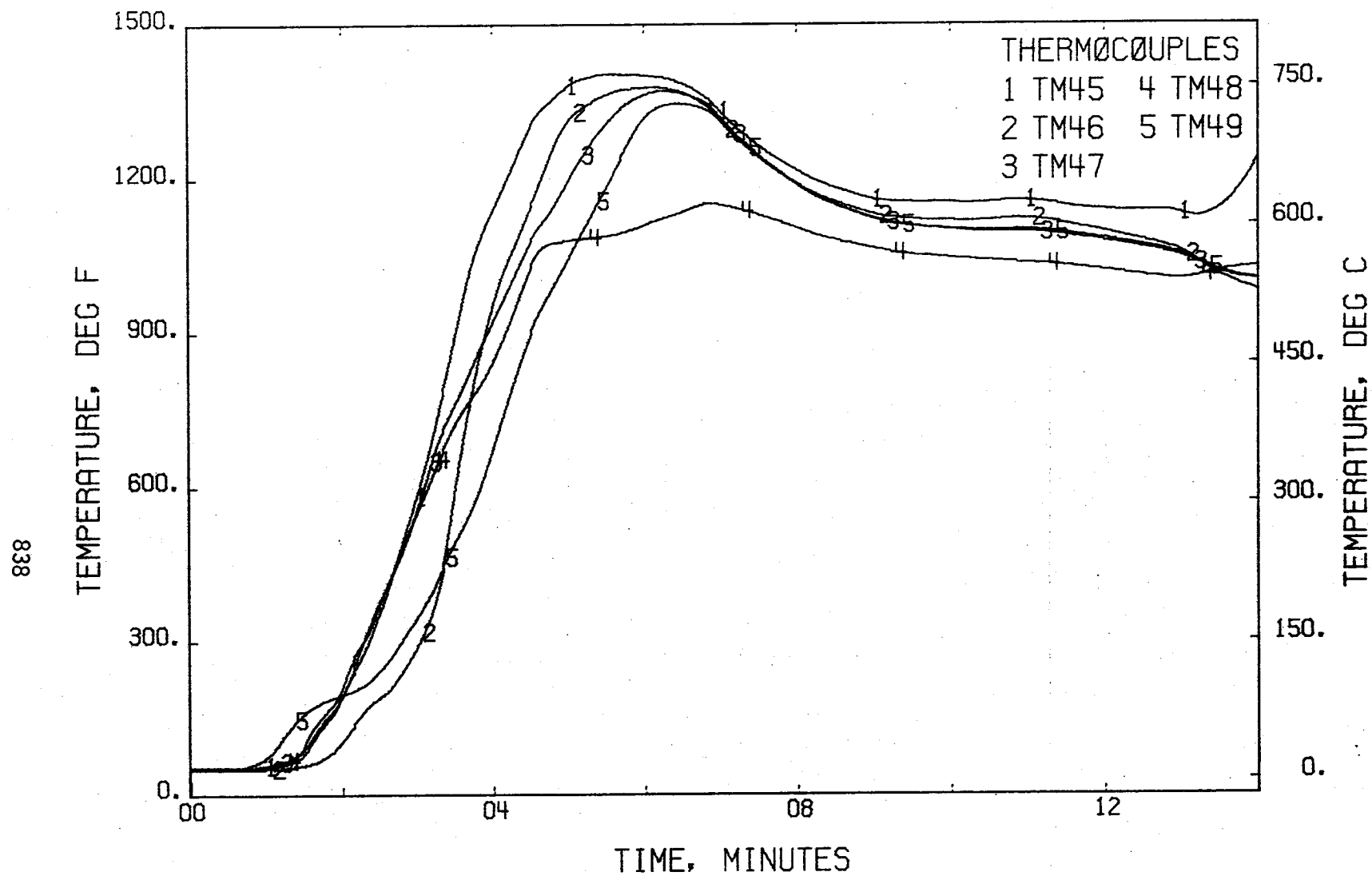


FIGURE 686 . - TEMPERATURES, SIDEWALL PANEL (REAR)  
TEST 28

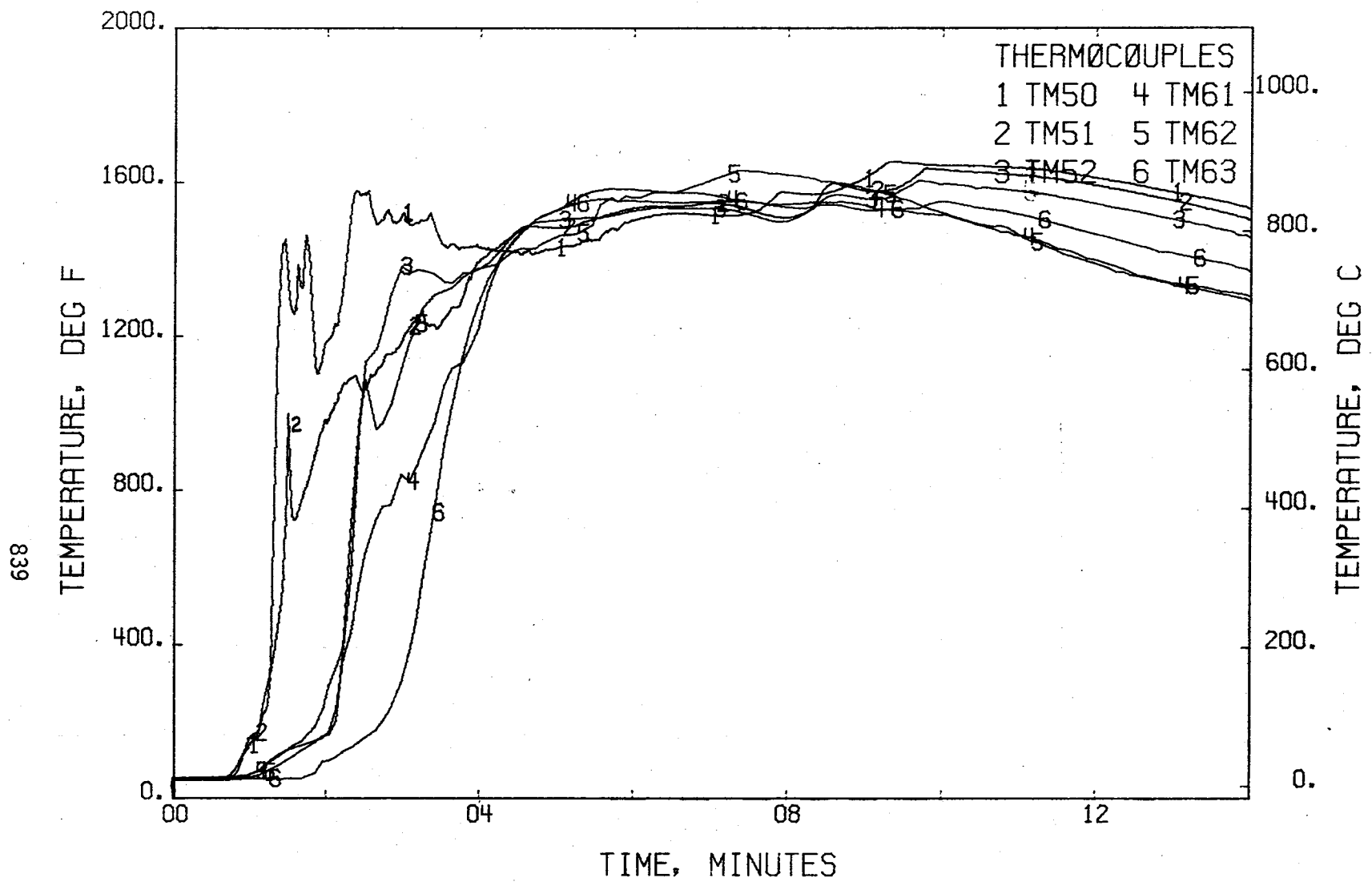


FIGURE 687 . - TEMPERATURES, SEAT CUSHIONS (TOP + BOTTOM)  
TEST 28

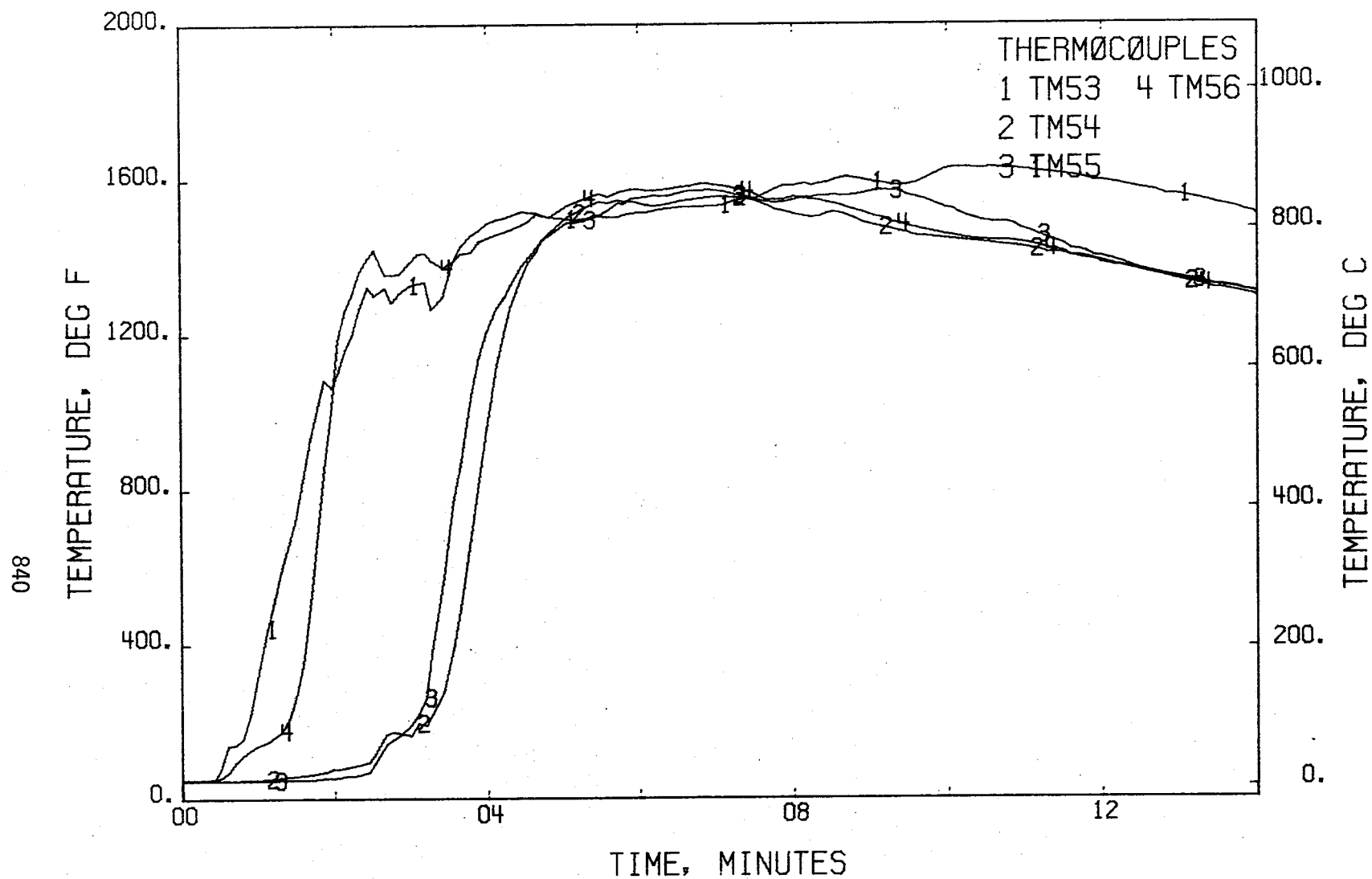


FIGURE 688 . - TEMPERATURES, SEAT CUSHIONS (EDGES)  
TEST 28



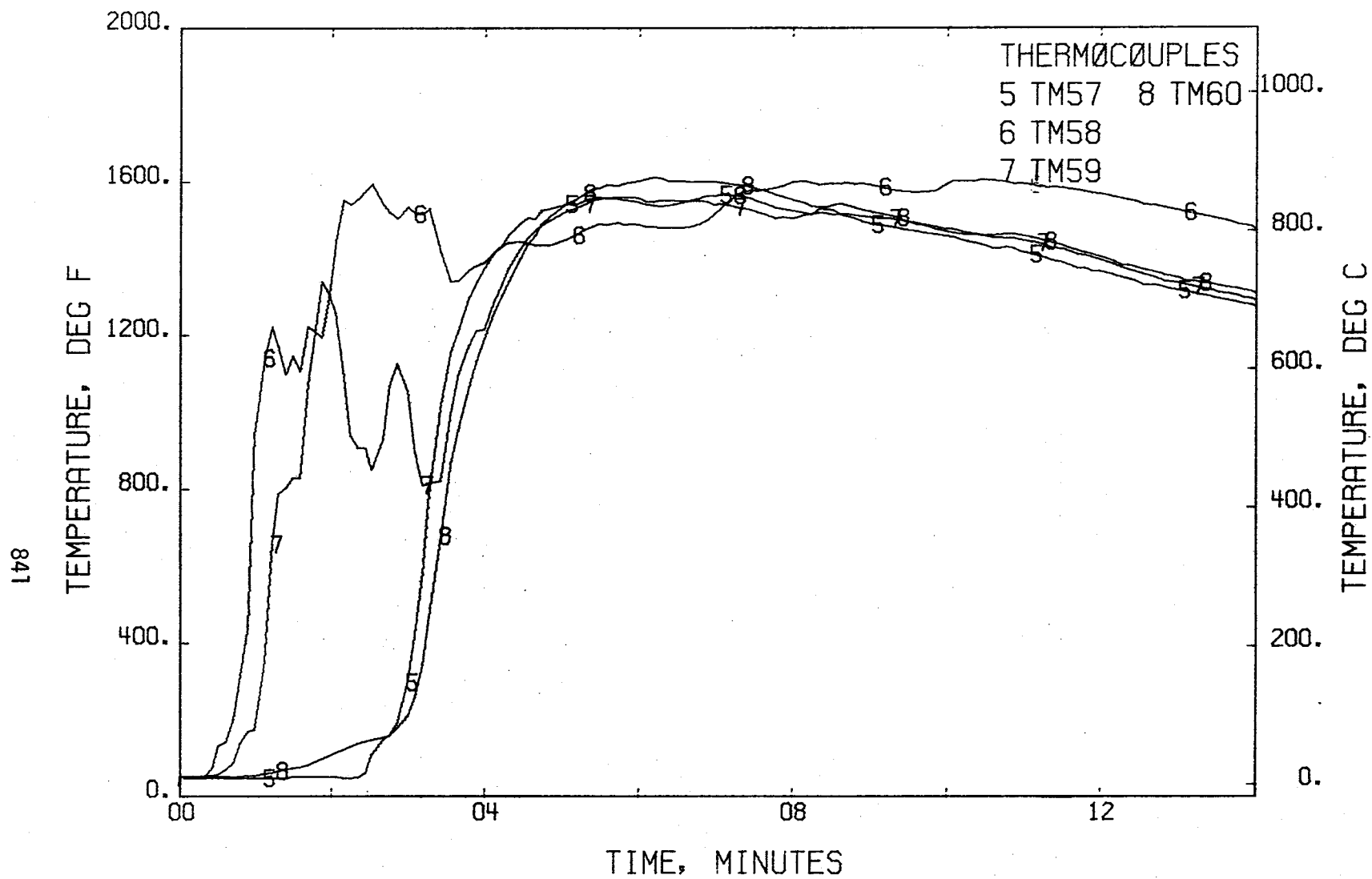


FIGURE 688 . - TEMPERATURES, SEAT CUSHIONS (EDGES) - CONT.  
TEST 28

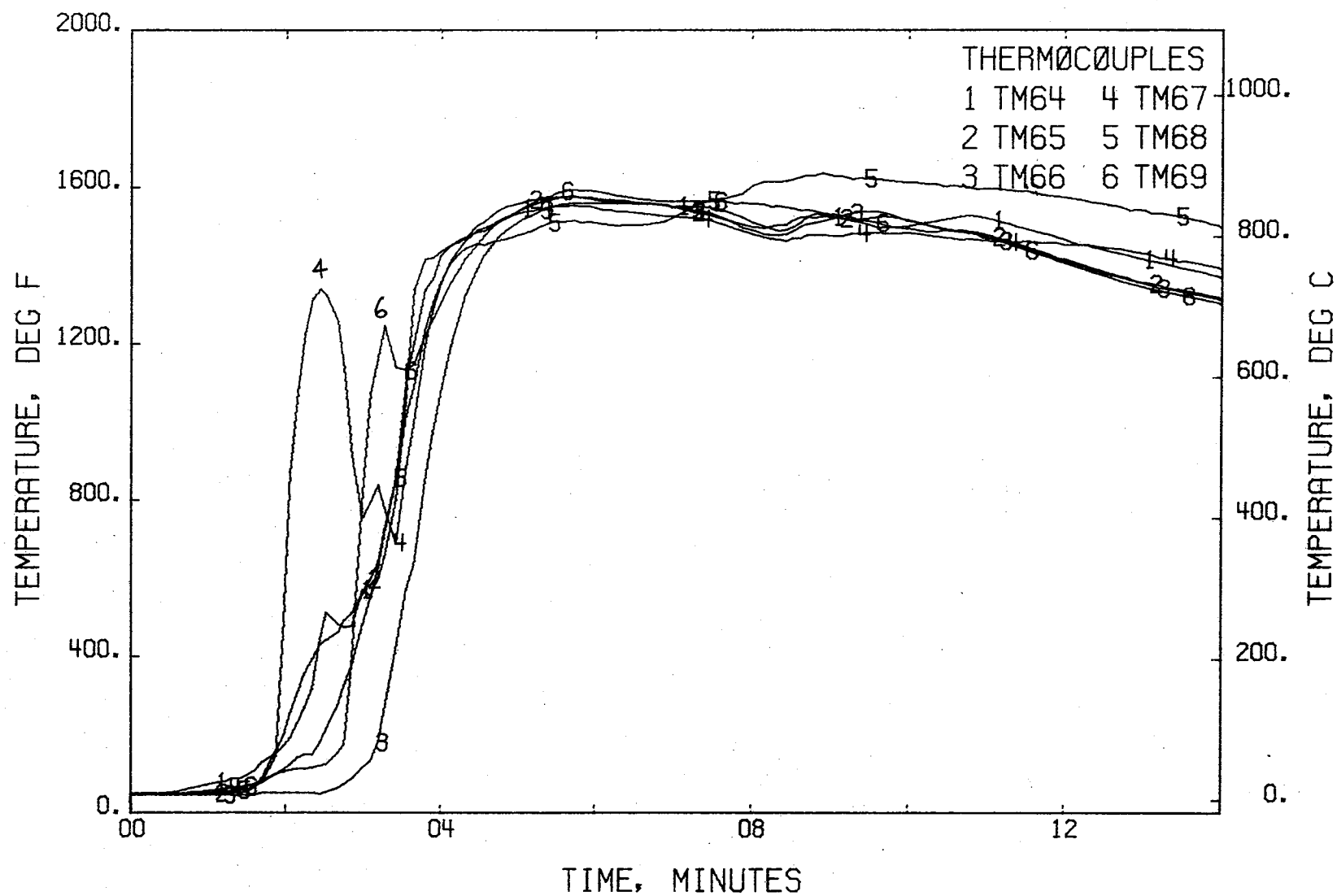


FIGURE 689 . - TEMPERATURES, SEAT BACKS (REAR)  
TEST 28

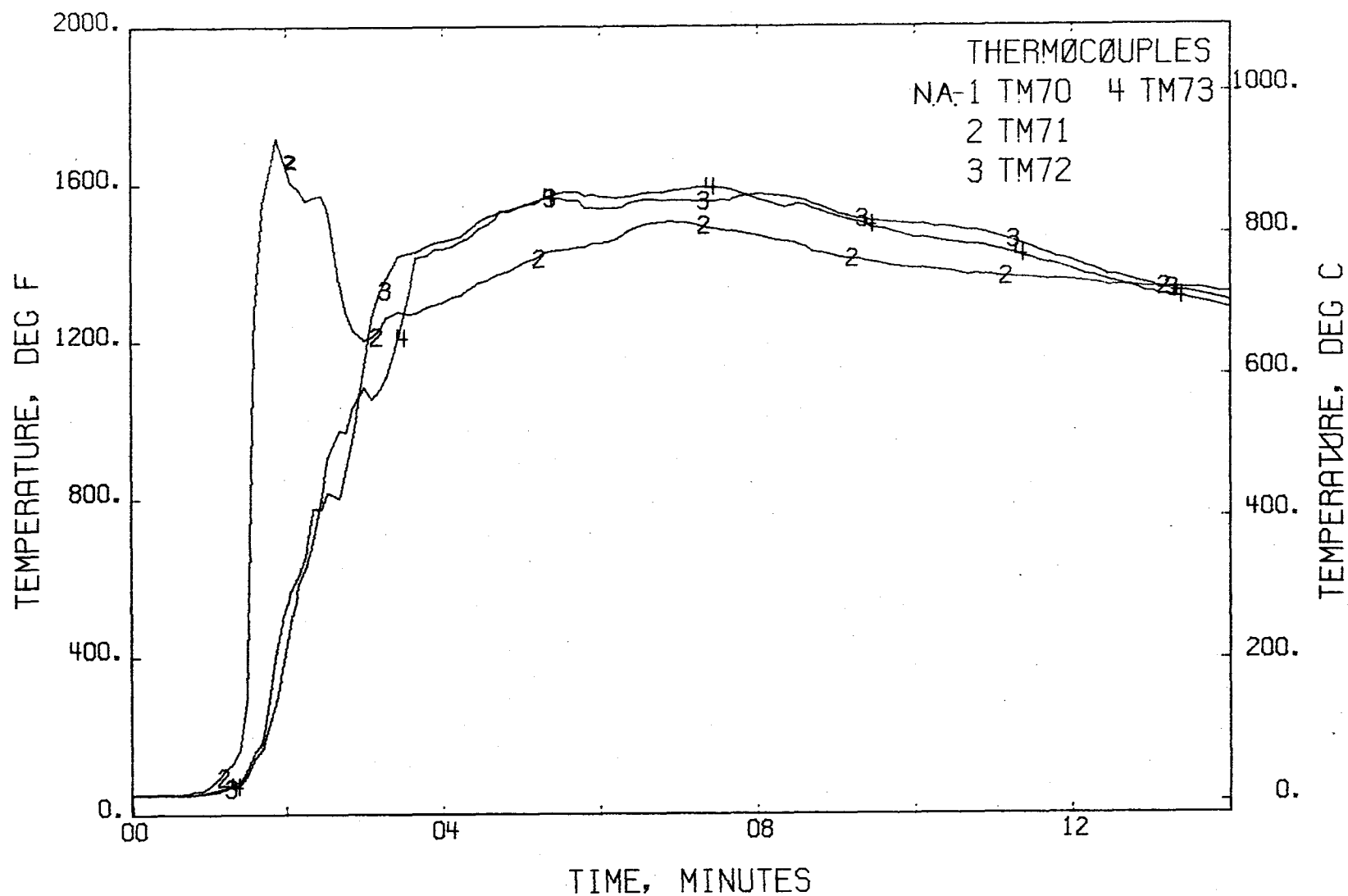


FIGURE 690 .- TEMPERATURES, SEAT BACKS (EDGES)  
TEST 28

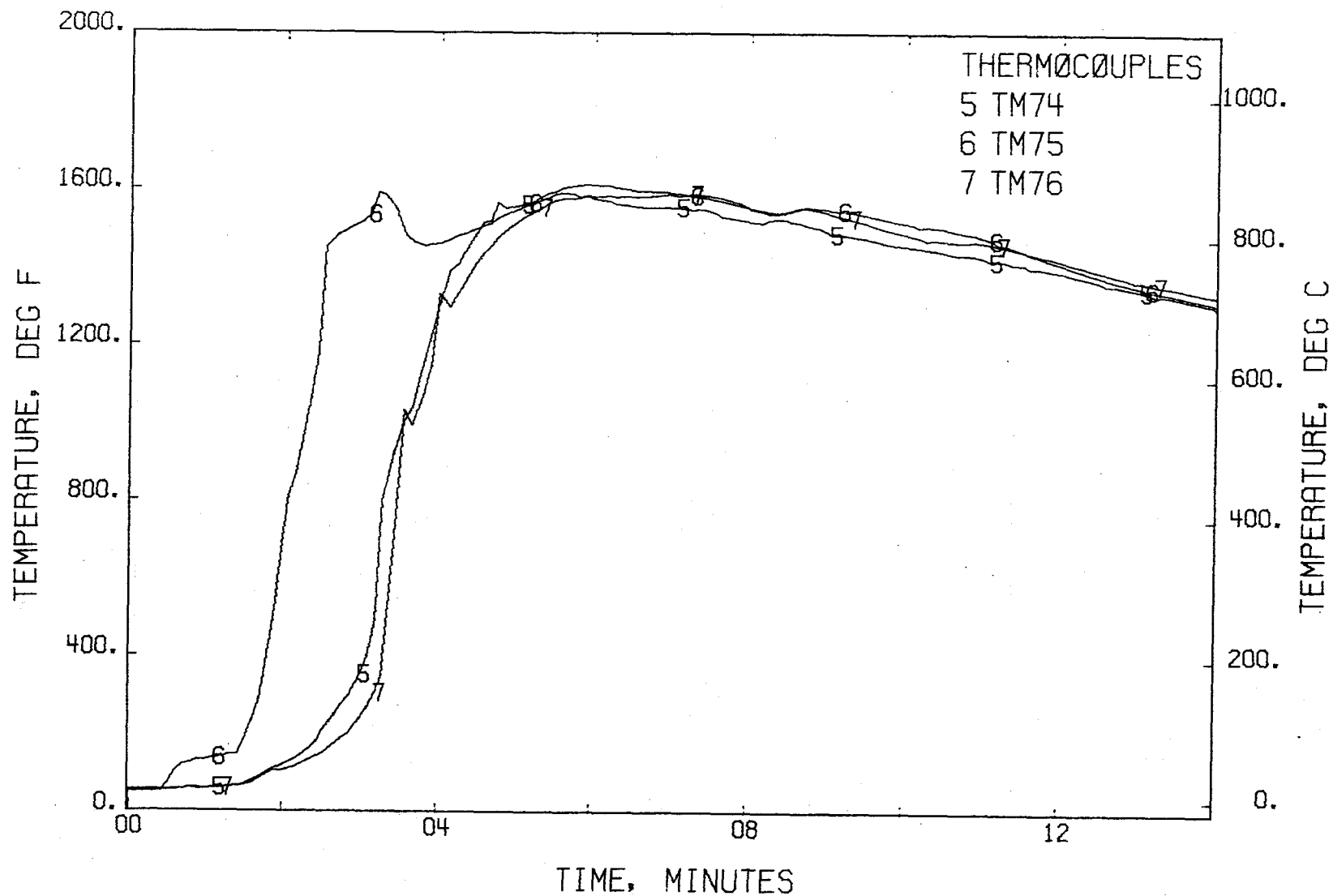


FIGURE 690. - TEMPERATURES, SEAT BACKS (EDGES) - CONT.  
TEST 28

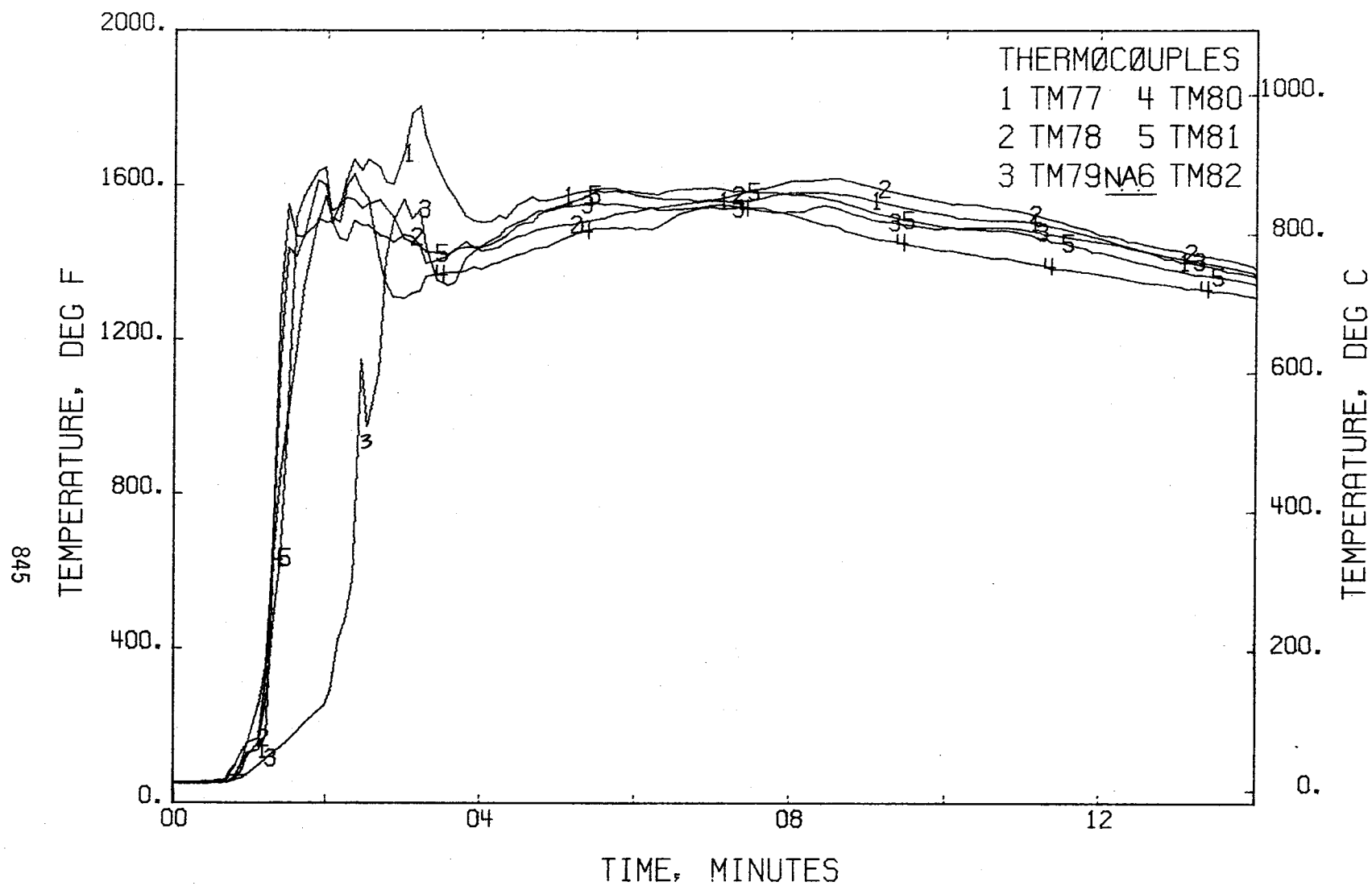


FIGURE 691 .- TEMPERATURES, SEAT BACKS (FRONT)  
TEST 28

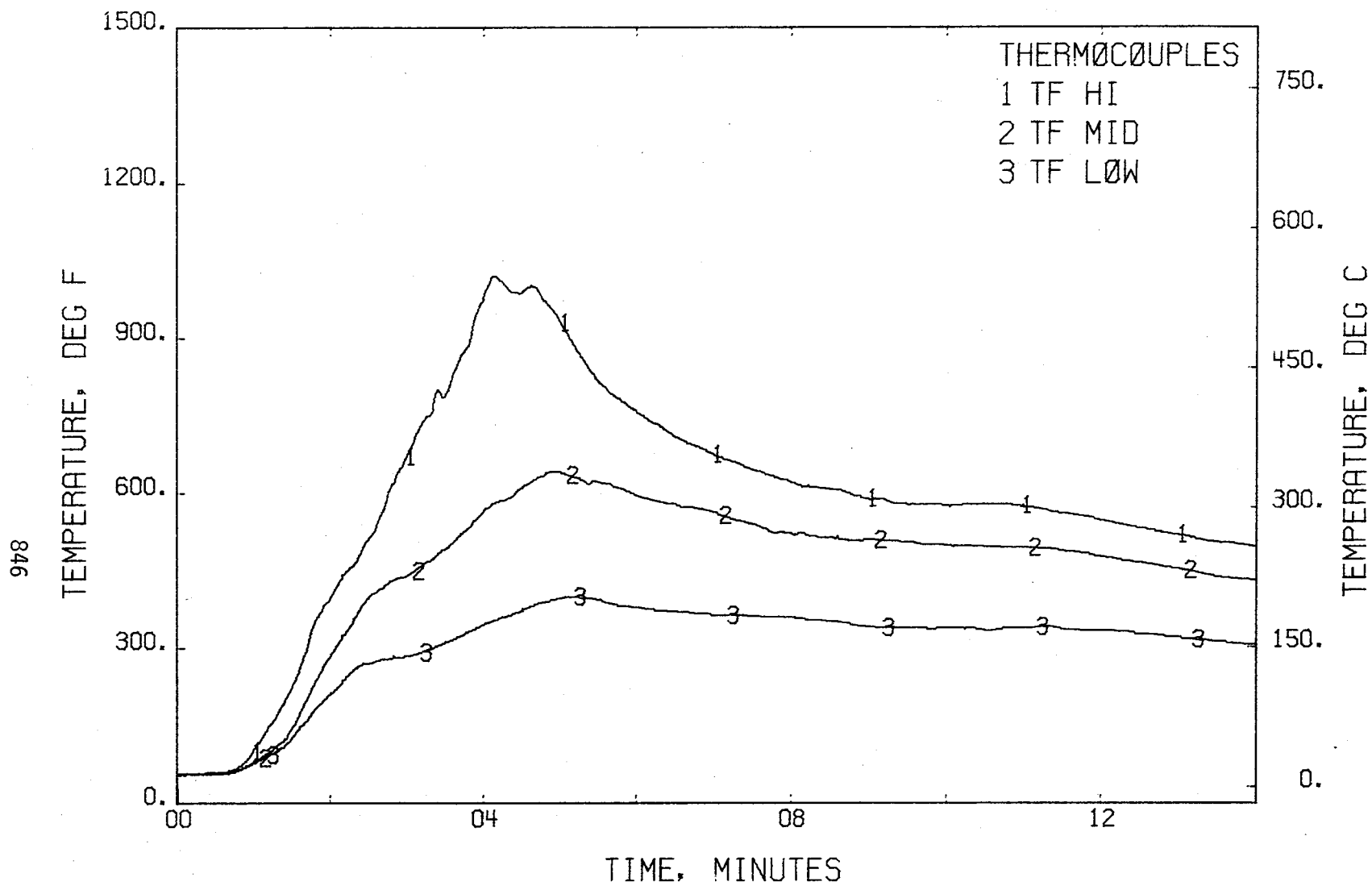


FIGURE 692 . - TEMPERATURES, ABOVE FUEL PAN  
TEST 28

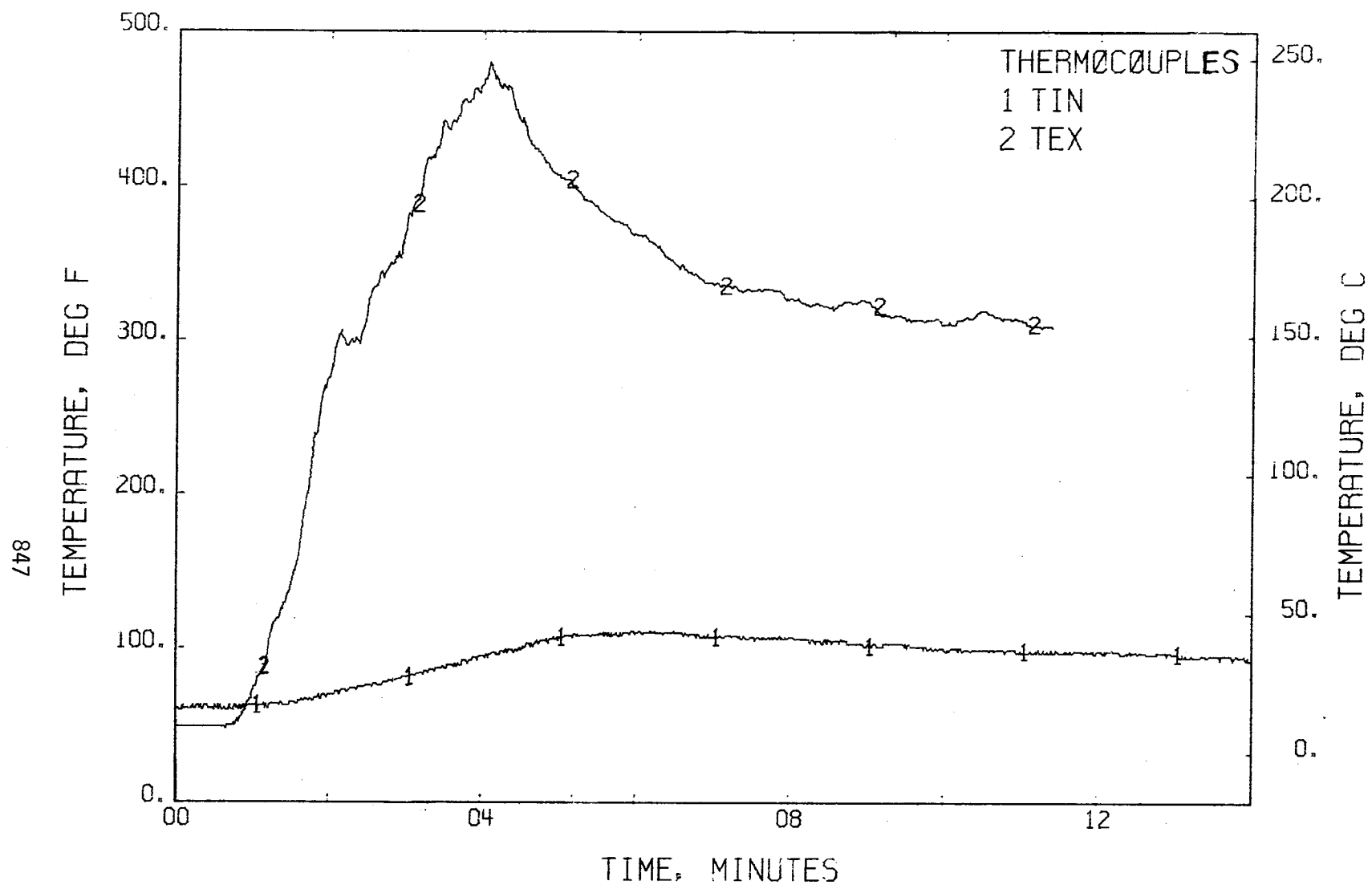


FIGURE 693 . - TEMPERATURES, INLET + EXIT  
TEST 28

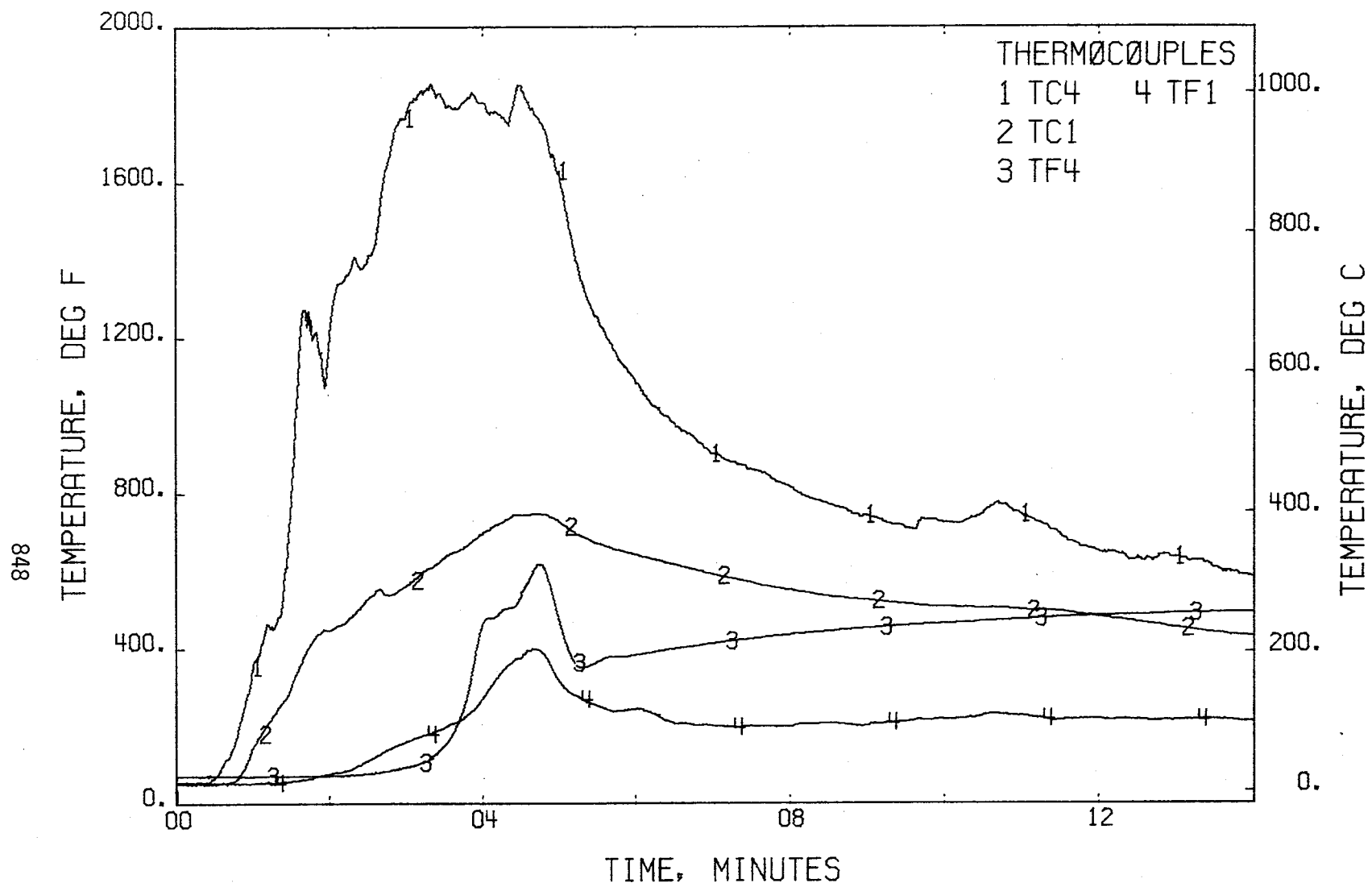


FIGURE 694 . - TEMPERATURES, CEILING + FLOOR (TREES 1+4)  
TEST 28



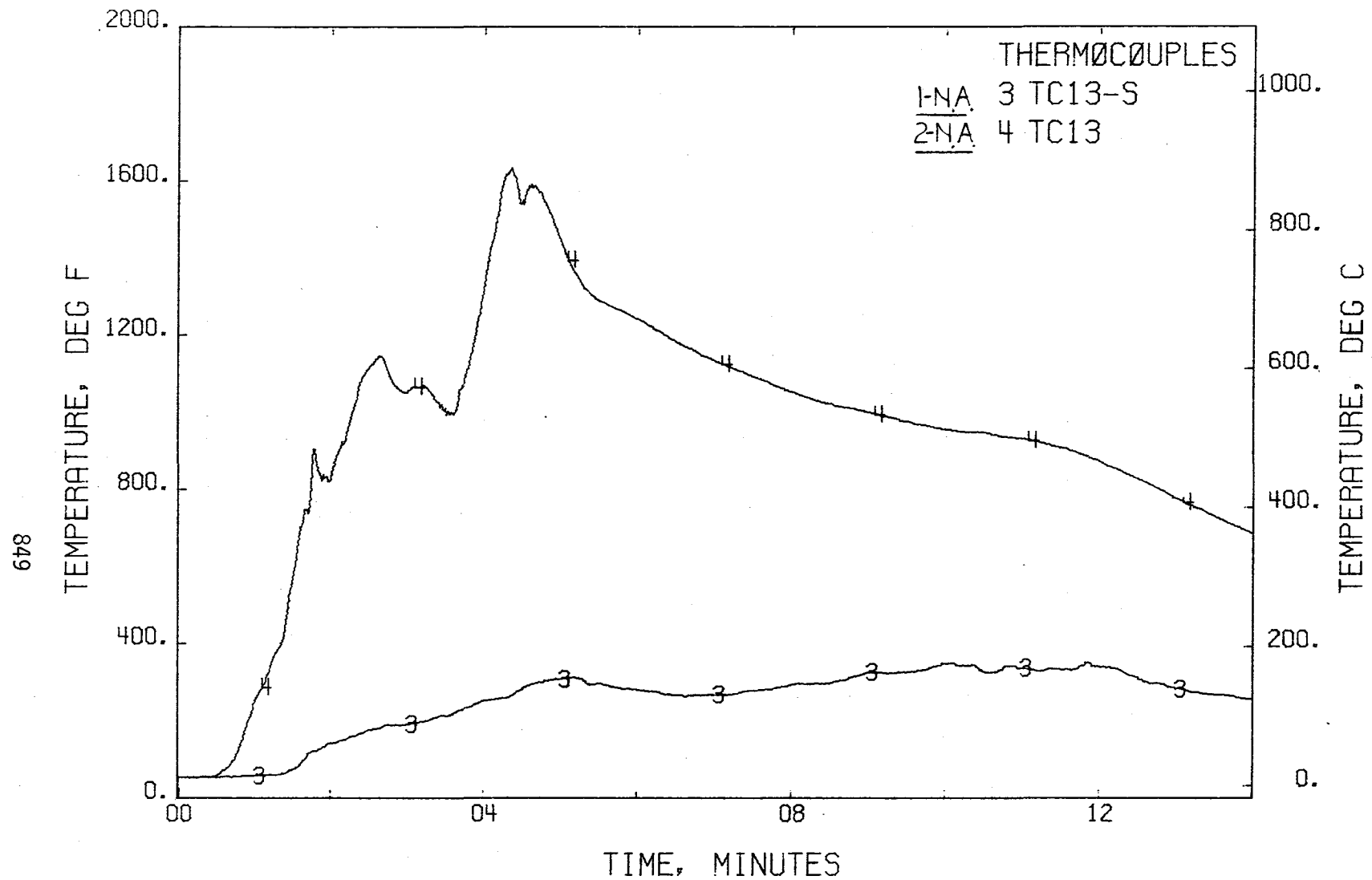


FIGURE 695 . - TEMPERATURES, SHIELDED VS UNSHIELDED T/C'S  
TEST 28

850

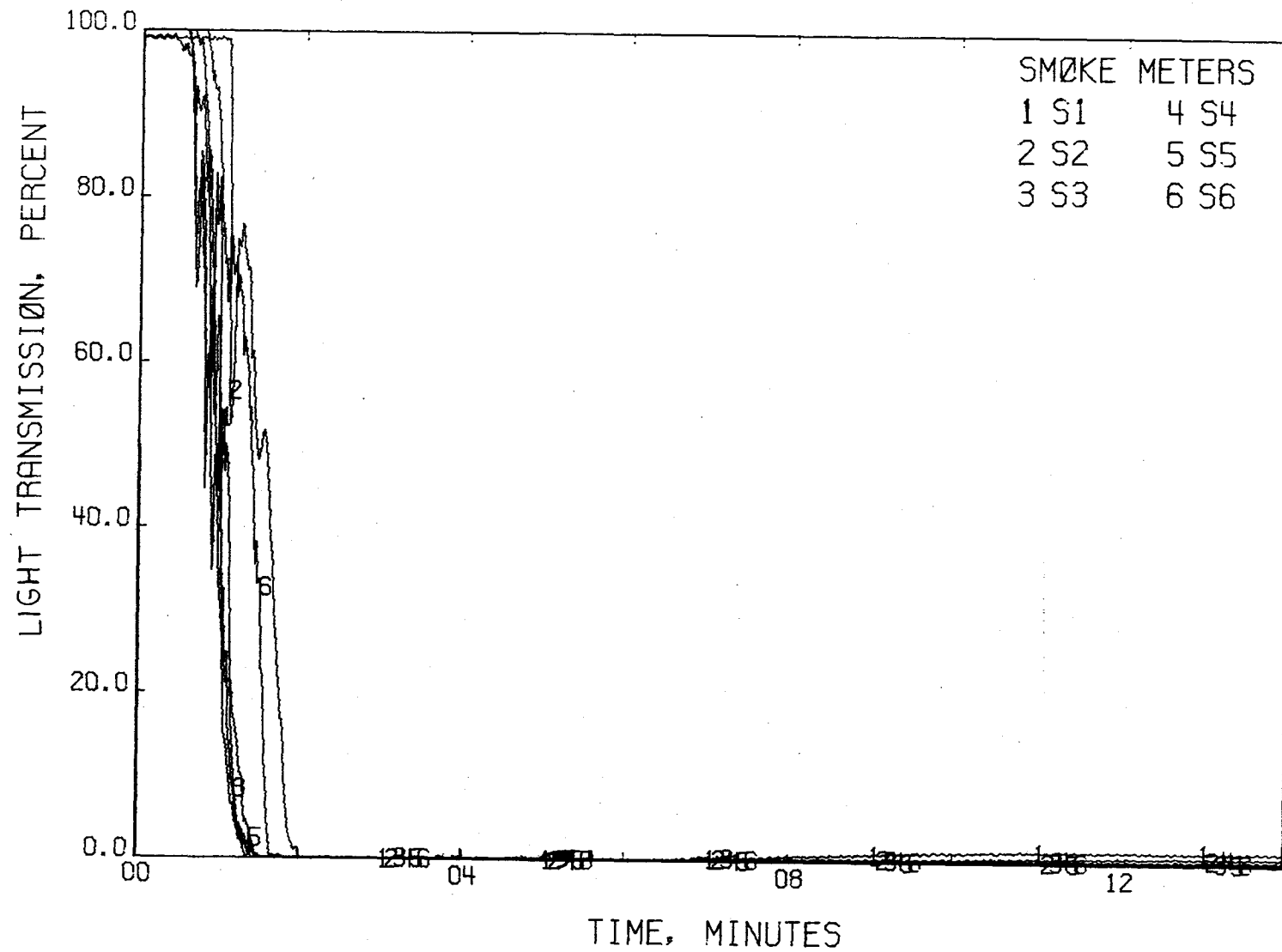


FIGURE 696 . - LIGHT TRANSMISSION  
TEST 28

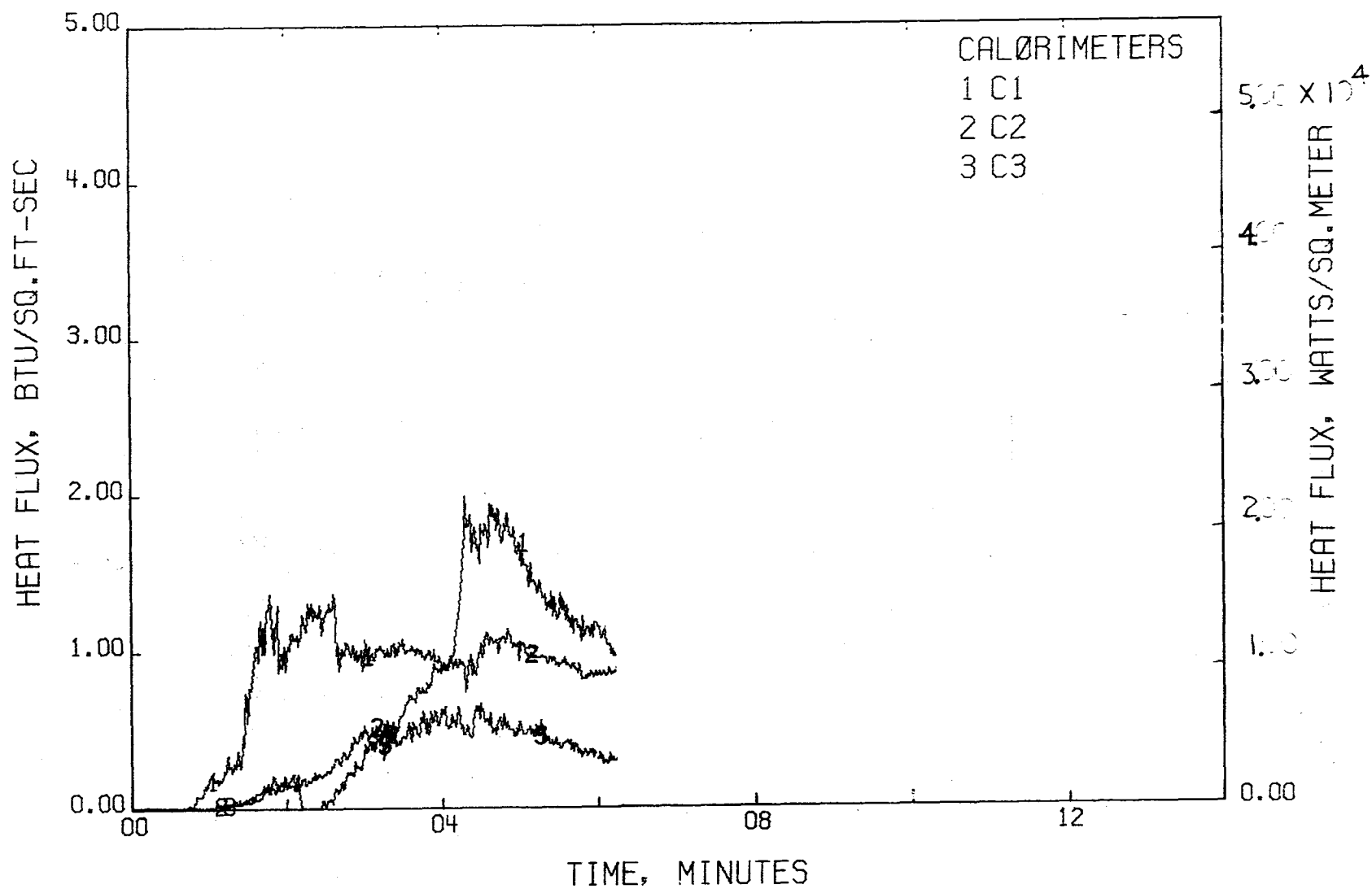


FIGURE 697 . - HEAT FLUX, AFT  
TEST 28

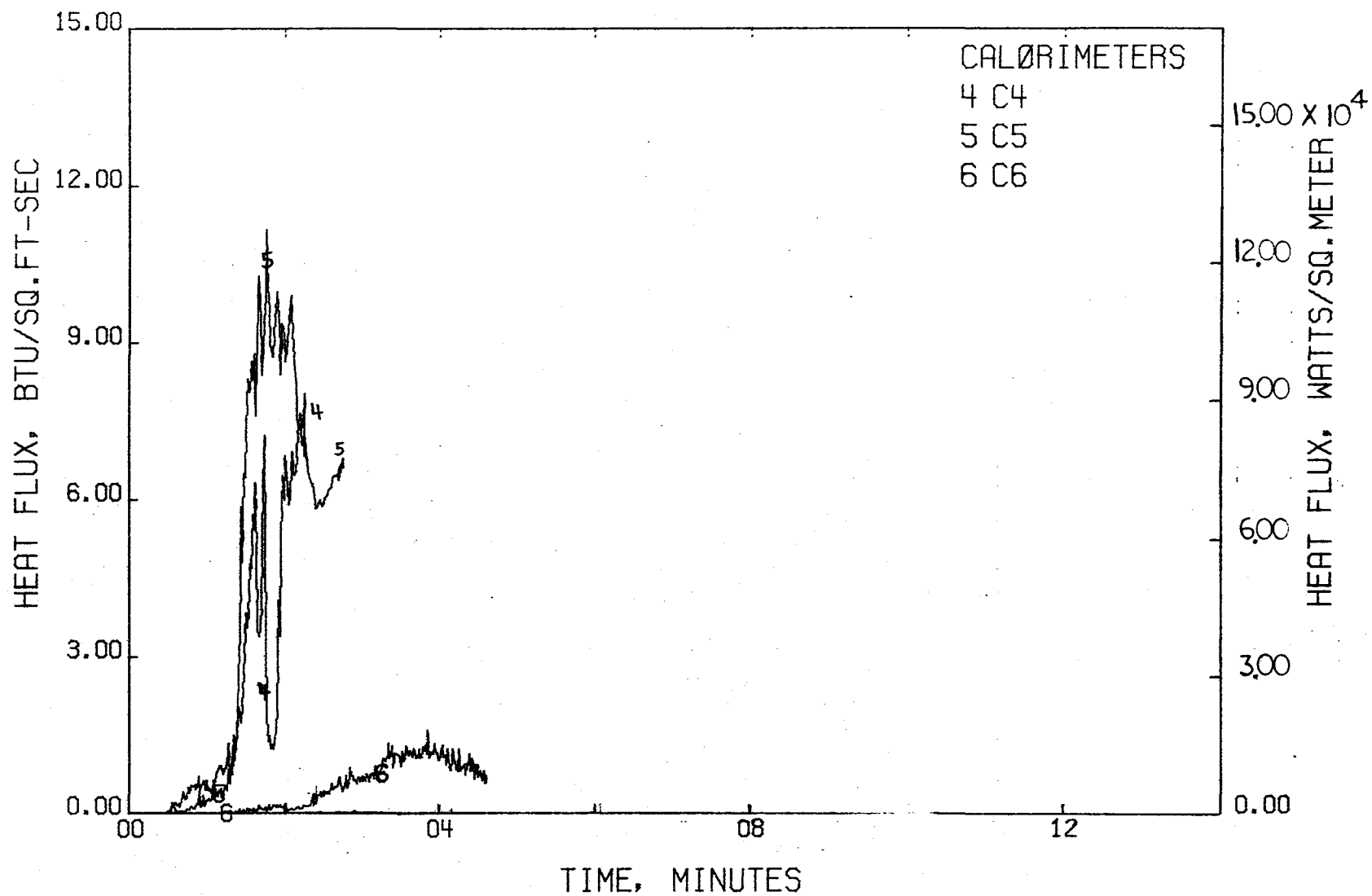


FIGURE 698 . - HEAT FLUX, MIDSECTION  
TEST 28

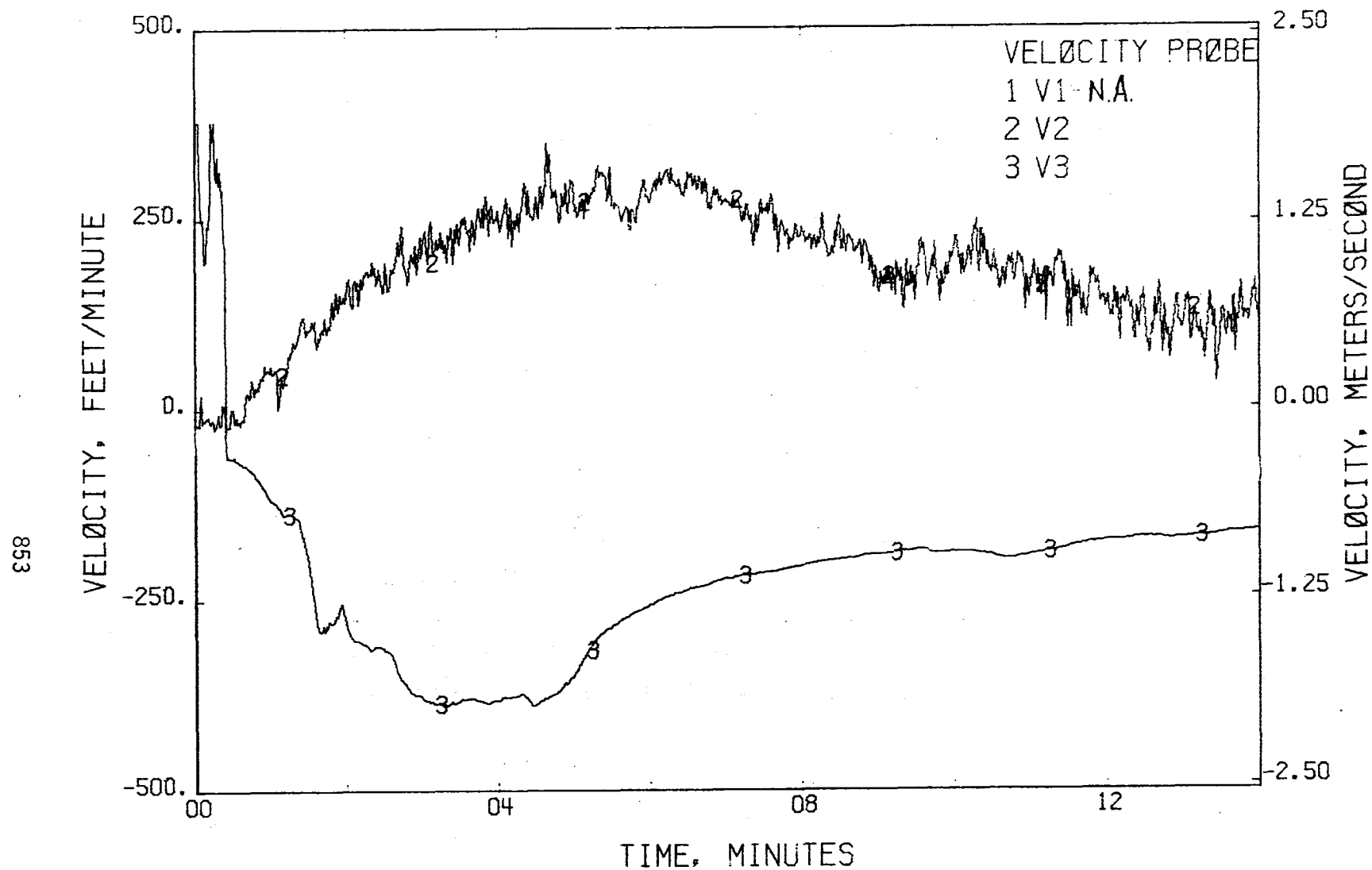


FIGURE 699 . - AIR VELOCITY  
TEST 28

DUE TO EQUIPMENT PROBLEMS, IT WAS NOT POSSIBLE TO  
OBTAIN ANY DATA IN THIS TEST FOR:

---

- o FUEL WEIGHT LOSS
- o SEAT WEIGHT LOSS

FUEL AND SEAT WEIGHT LOSS

TEST 28

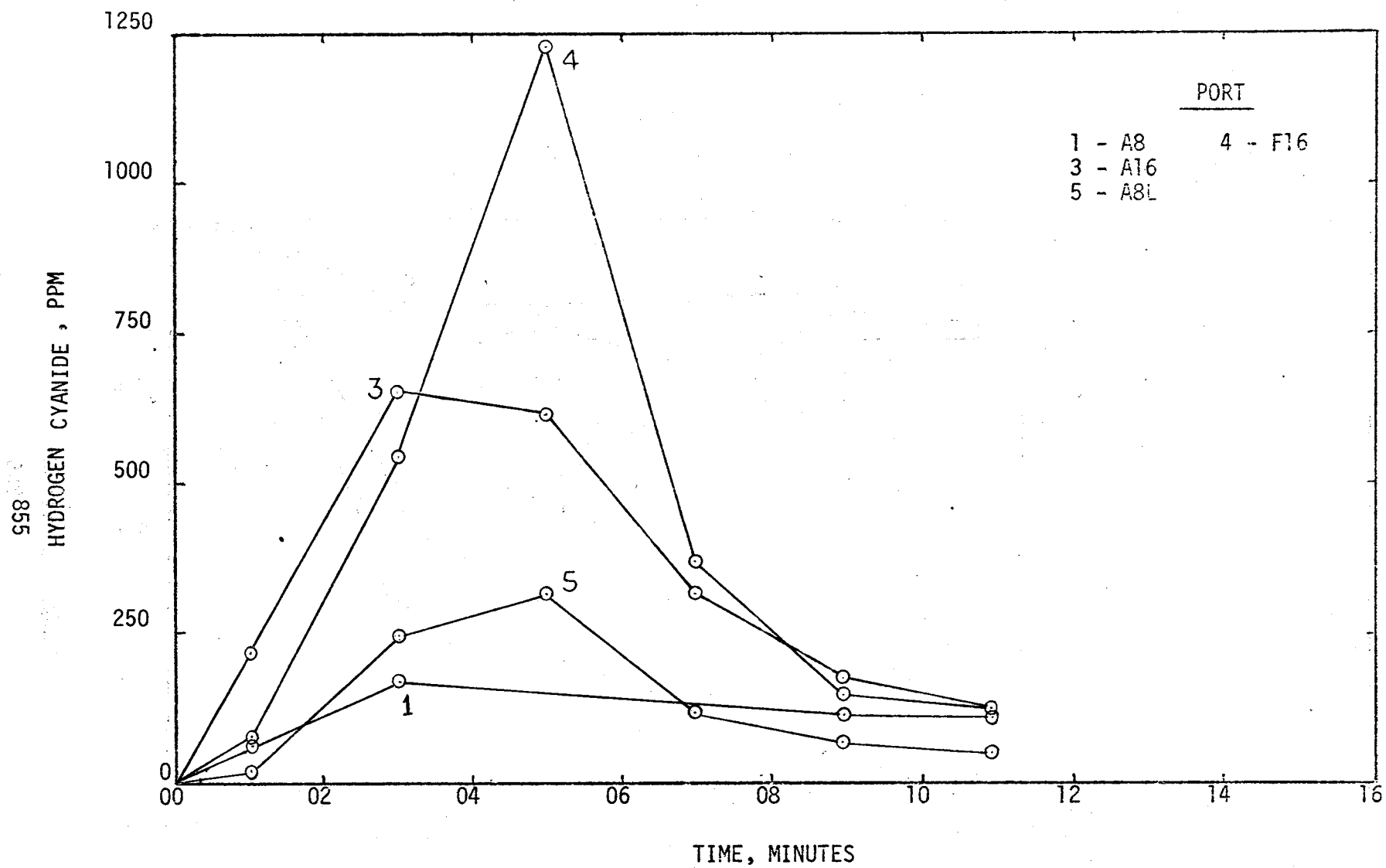


FIGURE 700 . - HYDROGEN CYANIDE CONCENTRATIONS

TEST 28

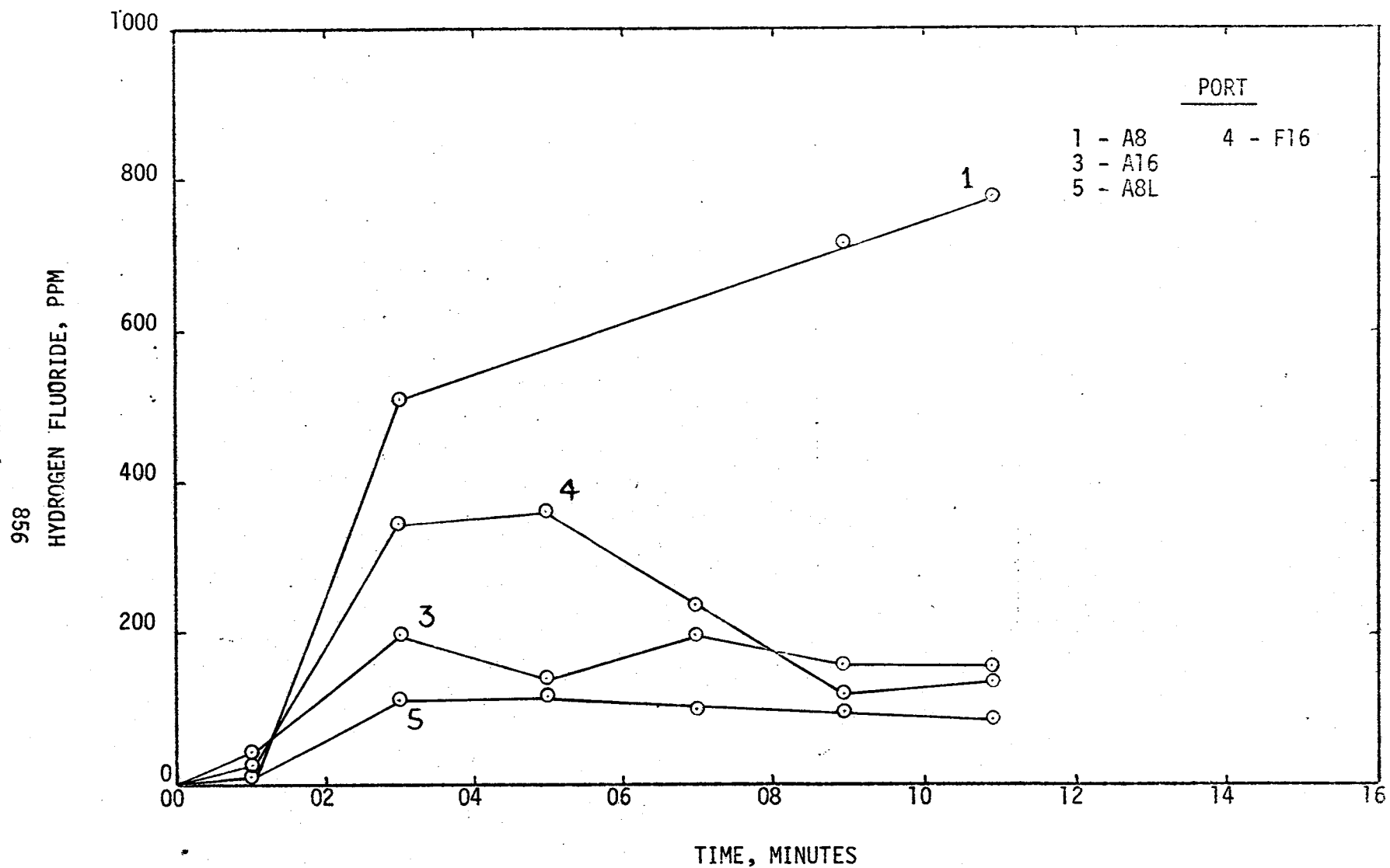


FIGURE 701 - HYDROGEN FLUORIDE CONCENTRATIONS

TEST 28



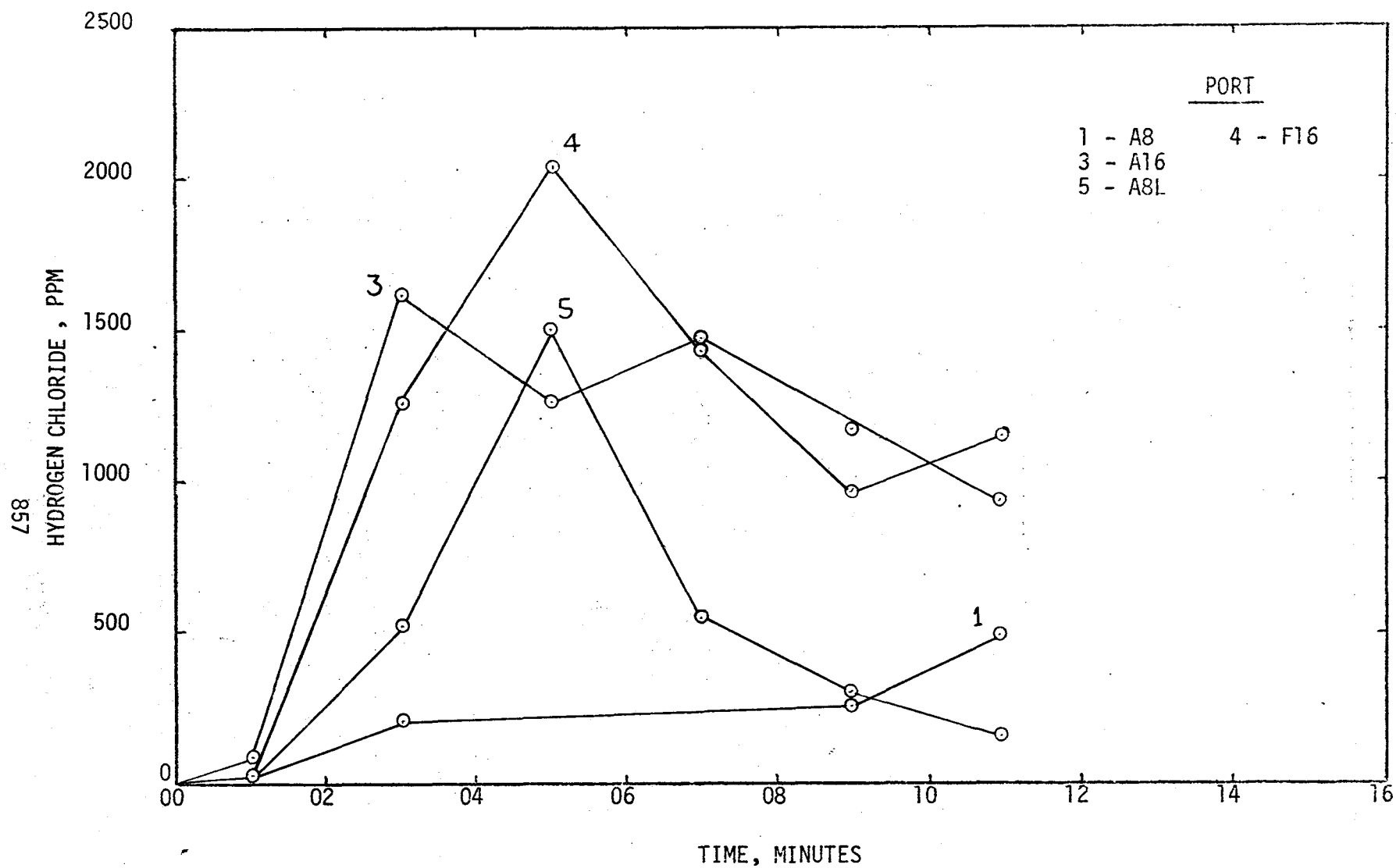


FIGURE 702 . - HYDROGEN CHLORIDE CONCENTRATIONS

TEST 28

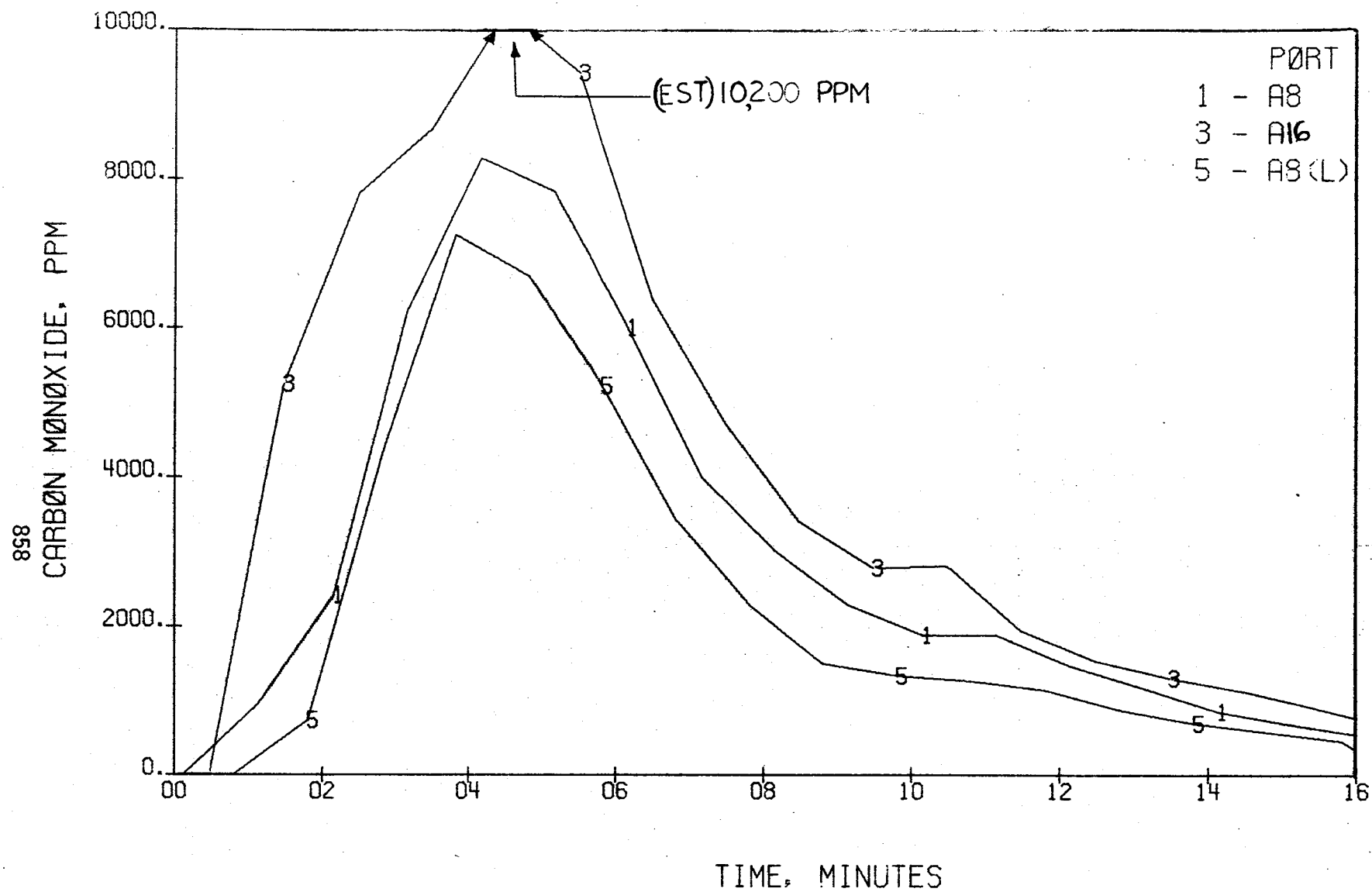


FIGURE 703 .-CARBON MONOXIDE CONCENTRATIONS, AFT

TEST 28

659

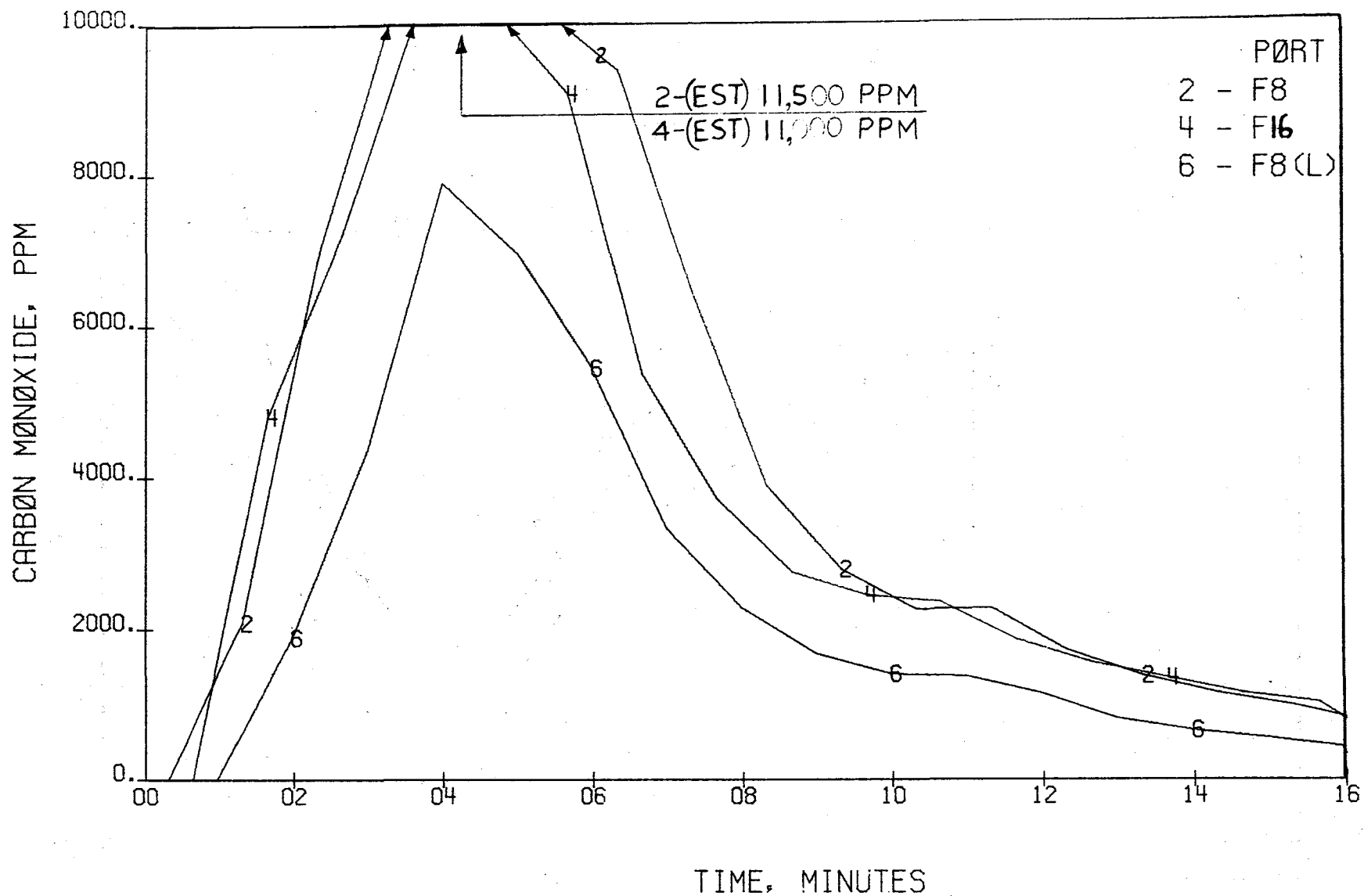


FIGURE 704 .-CARBON MONOXIDE CONCENTRATIONS, FØRE

TEST 28

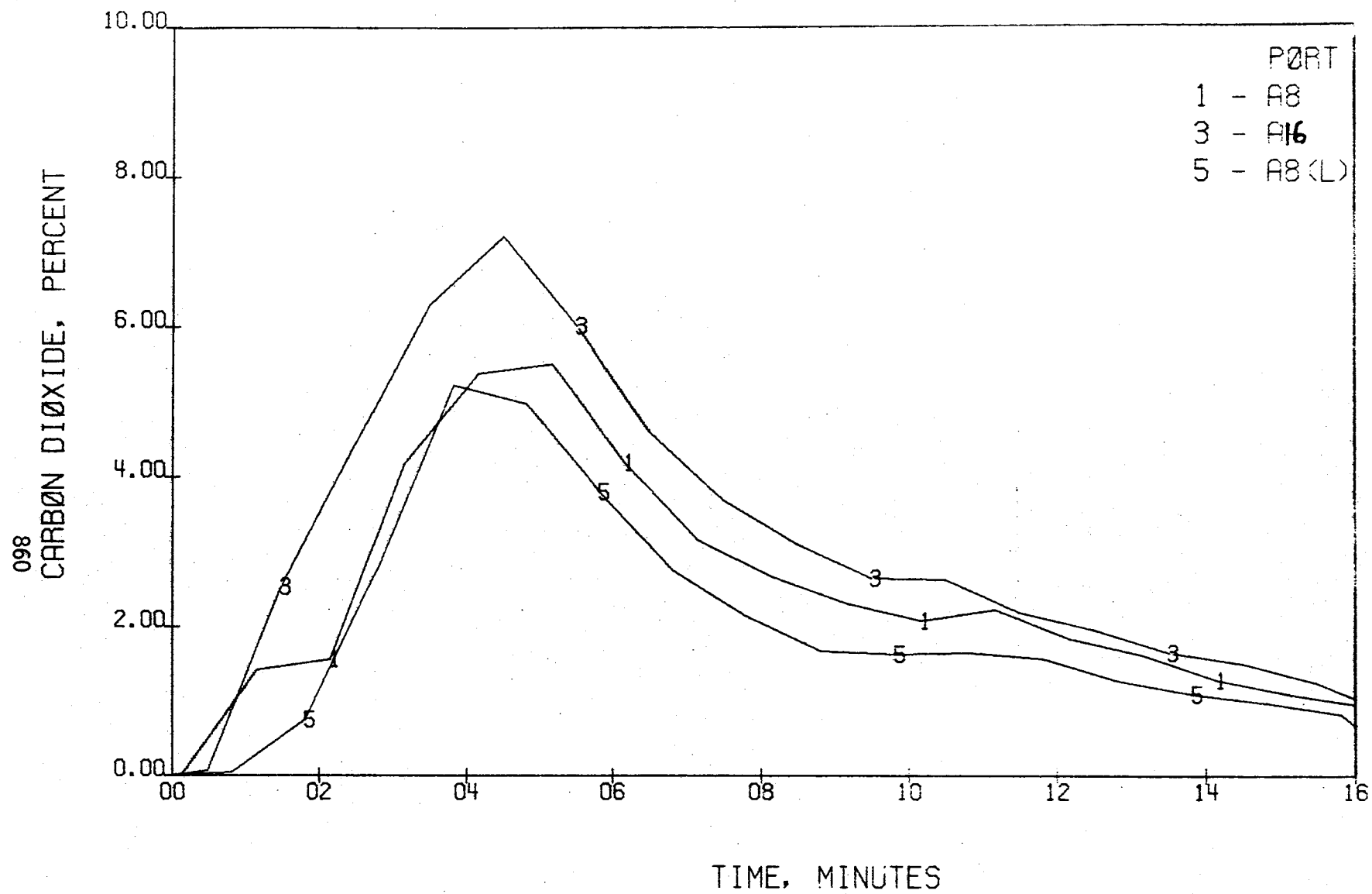


FIGURE 705 .-CARBON DIOXIDE CONCENTRATIONS , AFT  
TEST 28

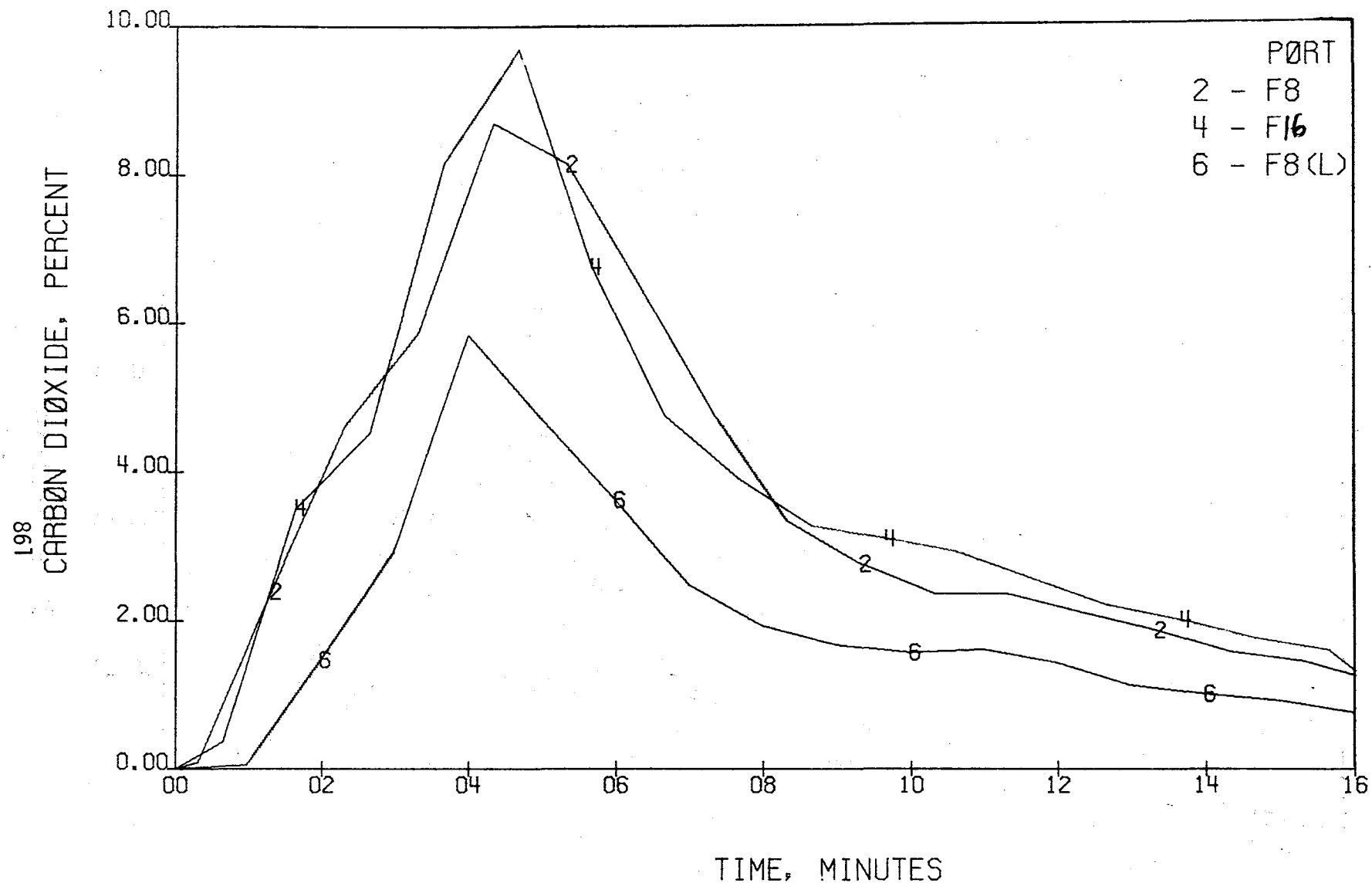


FIGURE 706 .-CARBON DIOXIDE CONCENTRATIONS, FØRE

TEST 28

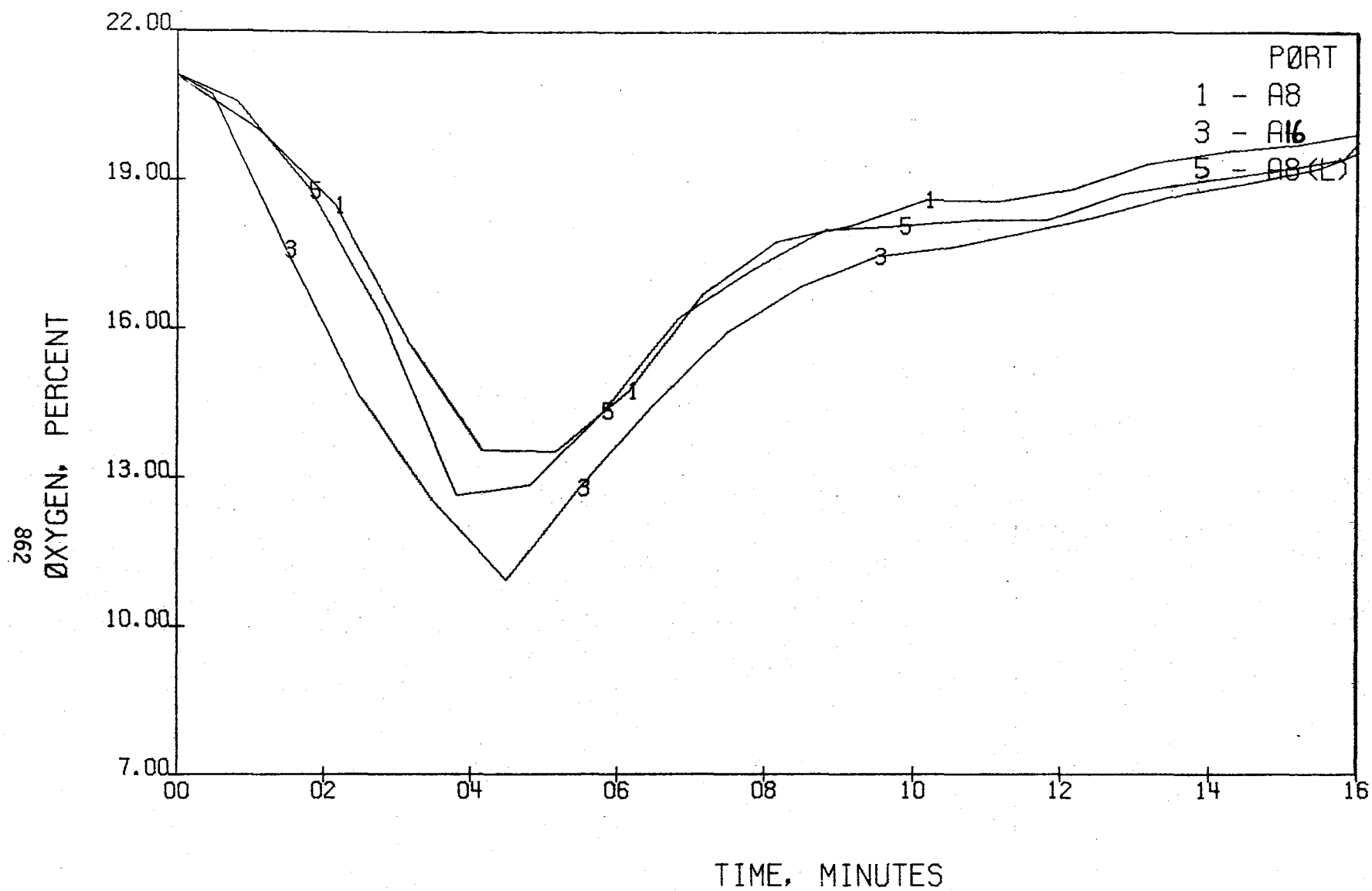


FIGURE 707 .-OXYGEN CONCENTRATIONS , AFT

TEST 28

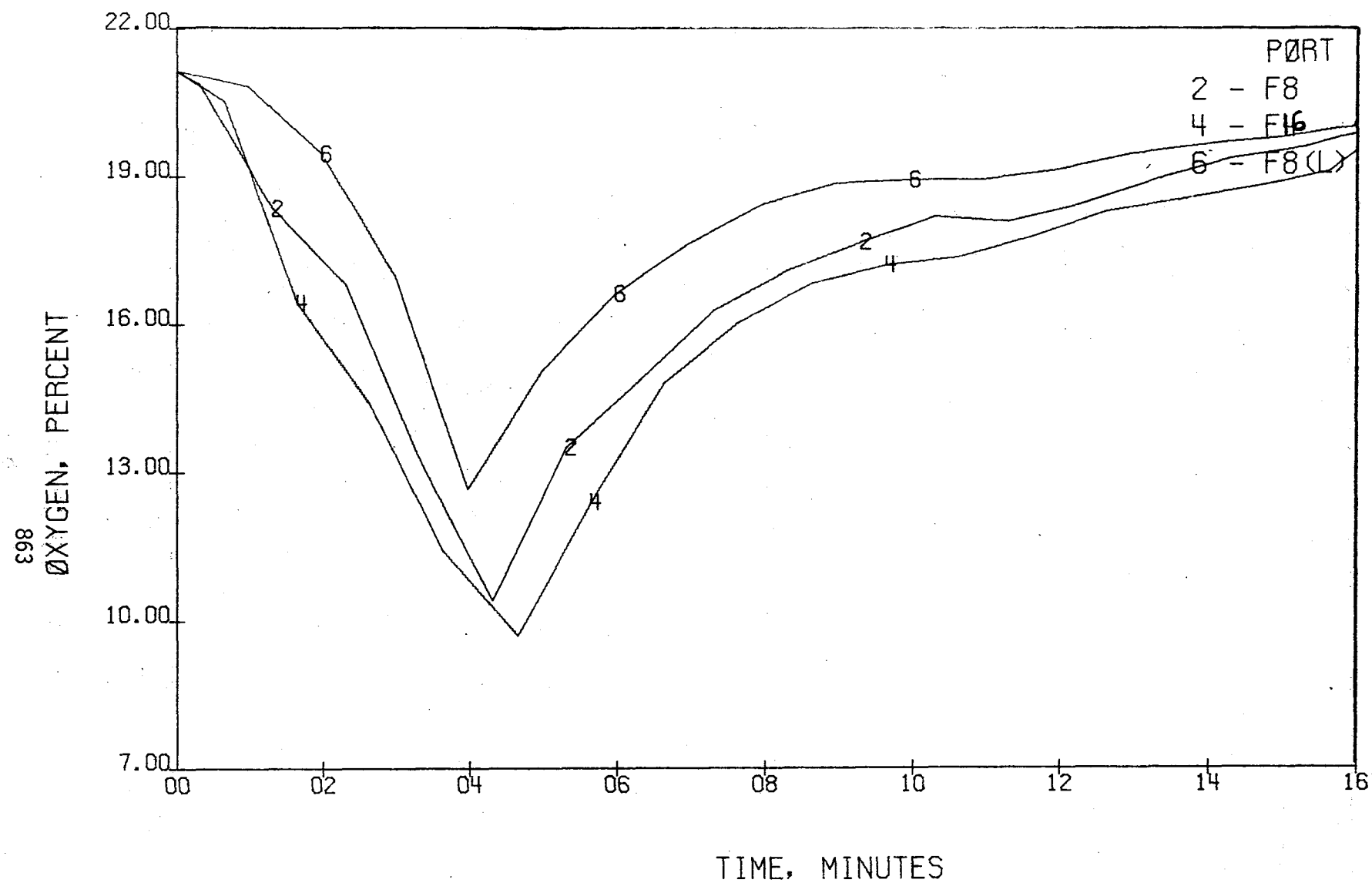


FIGURE 708 .-OXYGEN CONCENTRATIONS, FØRE

TEST 28

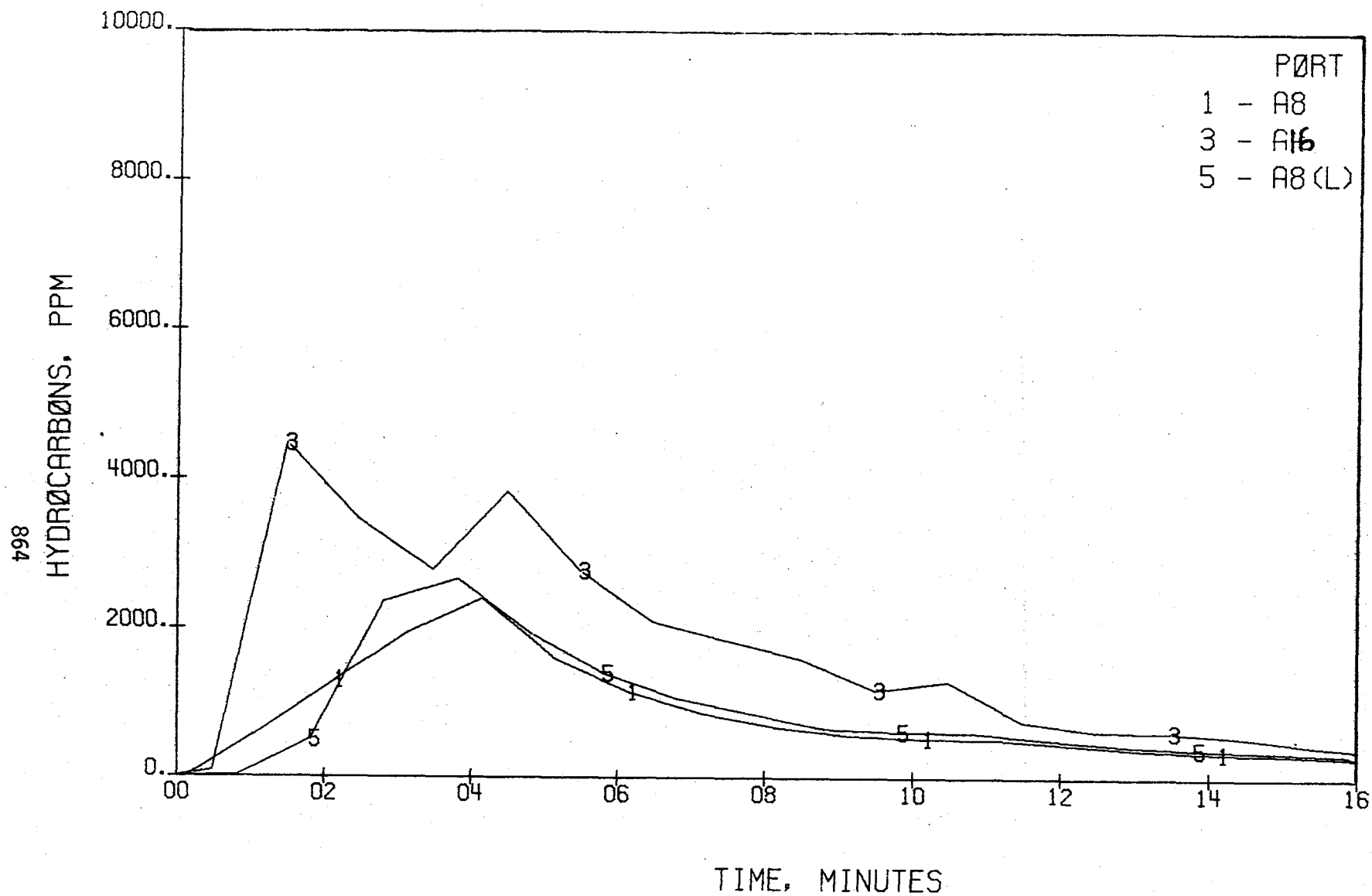


FIGURE 709 .-HYDROCARBONS CONCENTRATIONS , AFT  
TEST 28



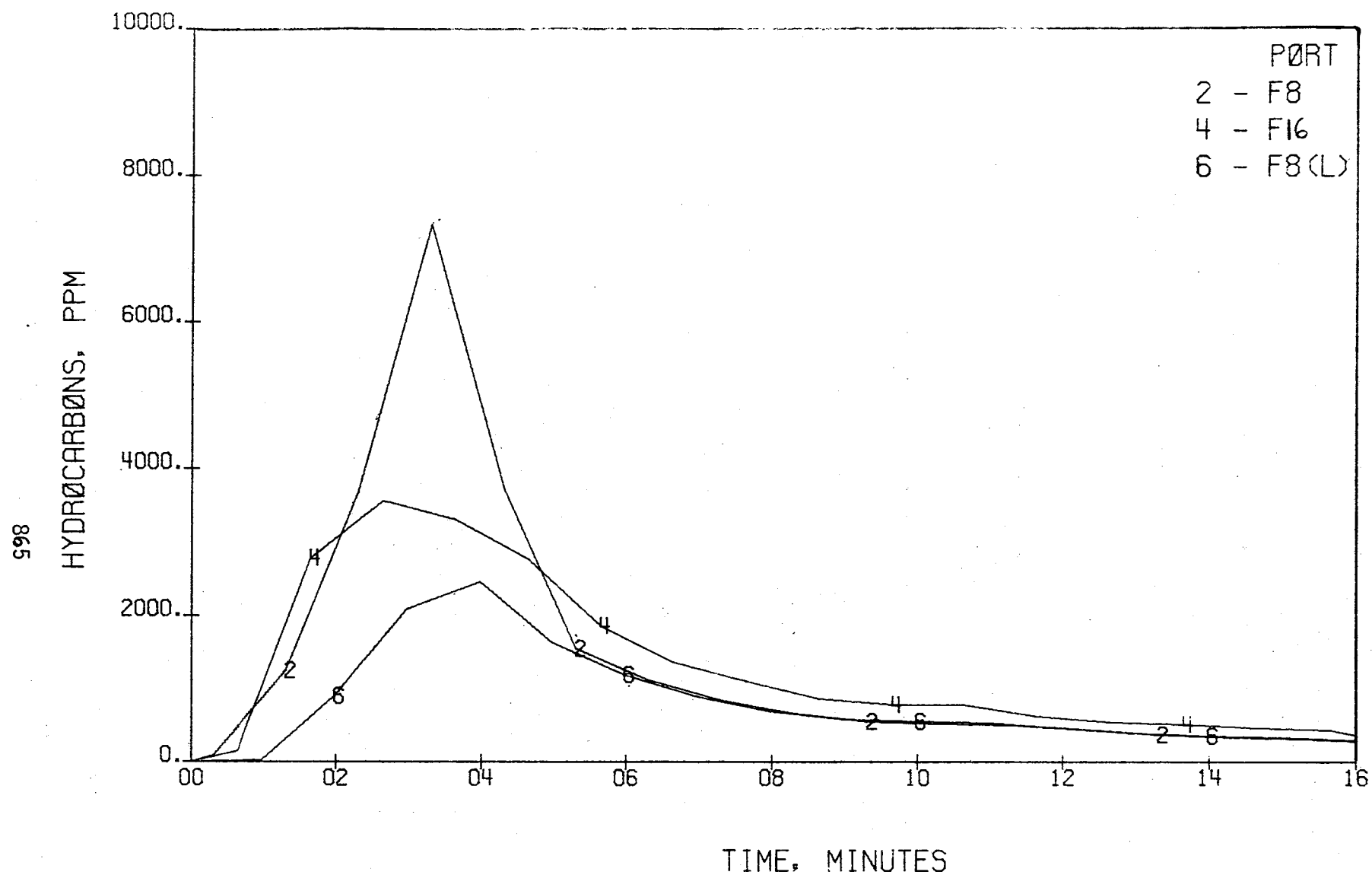


FIGURE 710 .-HYDRØCARBØNS CØNCENTRATIONS , FØRE

TEST 28

1. Report No. NASA TM- 58244		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Full-Scale Flammability Test Data for Validation of Aircraft Fire Mathematical Models				5. Report Date February 1982	
				6. Performing Organization Code	
7. Author(s) Jerome F. Kuminecz and Rickard W. Bricker				8. Performing Organization Report No.	
9. Performing Organization Name and Address Lyndon B. Johnson Space Center Houston, TX 77058				10. Work Unit No. 534-05-00-61-72	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546				13. Type of Report and Period Covered Technical Memorandum	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract  Twenty-five large-scale aircraft flammability tests were conducted in a Boeing 737 fuselage at the NASA Johnson Space Center (JSC). The objective of this test program was to provide a data base on the propagation of large-scale aircraft fires to support the validation of aircraft fire mathematical models.  Variables in the test program included cabin volume, amount of fuel, fuel pan area, fire location, air flow rate, and cabin materials. A number of tests were conducted with Jet A-1 fuel only, while others were conducted with various Boeing 747-type cabin materials. These included urethane foam seats, passenger service units, stowage bins, and wall and ceiling panels. Two tests were also included using special urethane foam and polyimide foam seats. Tests were conducted with each cabin material individually, with various combinations of these materials, and finally, with all materials in the cabin. The data include information obtained from approximately 160 locations inside the fuselage. Measurements include temperature, visibility, heat flux, air velocity, rate of fuel and seat-weight loss, and concentration of various gases. The data provided by this report include nearly 3000 curves (shown on 600 graphs). A matrix is included to quickly locate any particular graph. Approximately 50 before, during, and after test photographs are also included.					
17. Key Words (Suggested by Author(s)) Aircraft fire safety Flammability tests Fire-resistant materials Fire mathematical models Computer simulation of fires Aircraft cabin fire tests			18. Distribution Statement STAR Subject Category: 03 (Air Transportation and Safety)		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 876	
				22. Price*	



LANGLEY RESEARCH CENTER



3 1176 00504 0333